VOL. LXXVIII. No. 1993. [All Rights Reserved.] FRIDAY, FEBRUARY 4, 1916. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage.] PRICE FOURPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. SUBSCRIPTION per annum, Postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80); to all other countries, 30s.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, CAN.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie Etrangère, 22, Rue de la Banque.
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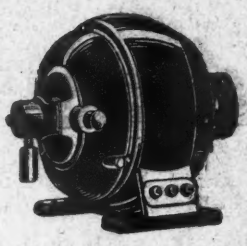

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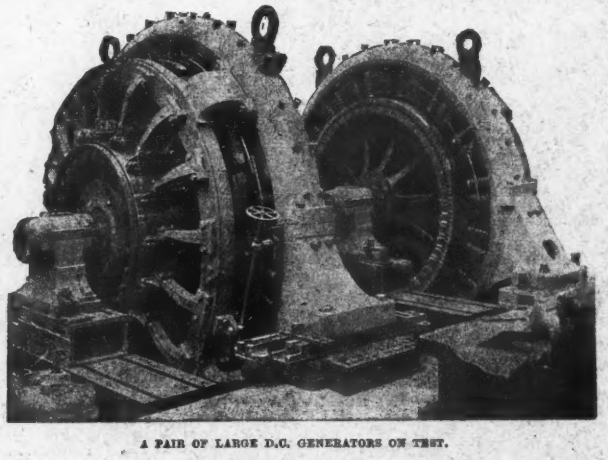

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ELECTRICAL REVIEW.

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THE DILUTION OF LABOUR.

A FORTNIGHT ago Mr. Asquith made an announcement in the House of Commons of far-reaching importance. He pointed out that "the adoption of dilution, that is to say, the employment during the war period of semi-skilled and unskilled and female labour on any class of work upon which it can be usefully employed, so as to set free skilled workmen for the work which they alone can perform, offers the only prospect of securing a sufficient supply of munitions to enable the war to be brought to a speedy and successful conclusion." He went on to point out that we cannot rely upon foreign supplies, because the demands upon our financial resources and our shipping would present insuperable difficulties. He also said: "The necessities of the war have been pointed out both to the owners of controlled establishments and to the representatives of the great trade unions, and they have loyally pledged themselves to support the Government in the scheme of labour dilution, the necessity for which has arisen from the national requirements and not from any demand by employers."

We have little doubt that the employers, so far as in them lies, are ready and willing to redeem their pledge. Wholly apart from the war, they have been striving for years past to get rid of the arbitrary distinction between skilled and unskilled labour. They have so striven in the interests of Labour itself. To them competition, whether at home or abroad, has been a reality; to the worker, the fact that the employer has been able to carry on at all is sufficient guaranty that the existing trade union rules are satisfactory in their operation.

We have no doubt either that the representatives of the great trade unions will do their best to redeem the pledge; but will those whom they purport to represent to their part? That is the real point. It is satisfactory to learn that during the last few days in various industrial centres the "dilution" process has at last been permitted to make some headway—for the period of the war. Perhaps Monday night's air-raid of industrial works may serve to hasten the rate of progress!

In the electrical industry where employers and men have played so prominent a part in the manufacture of munitions, we have no doubt that, given the necessary desire, the skilled men of to-day could do work more highly skilled, while the less skilled could soon, with practice, be made more adept. What the present "skilled worker" fears, we presume, is increased competition, and therefore lower wages, in that dim and distant epoch after the war. But we think he may set his mind at rest on that score. Increase the number of skilled workers up and down the country, and you necessarily increase the general capacity of the working community. Increase the capacity of our factories, and you increase output; and increase of output will be sorely needed after the war. If the worker at peaceful industry can be transformed into a munition worker, so the munition worker can, with equal facility, be transformed into an all-round artisan.

It is the abuse of the right of free speech which appears to hamper the Government in bringing the case-hardened trade unionist to see reason. There is the suggestion that no form of compulsion should be brought to bear upon the working man until there is "conscription of capital"; until the so-called rich man is made to surrender all his property to the Government. The "man on the barrel" who preaches such doctrines does not go on to remind his audience that income-tax has been increased by about 150 per cent., and that a Cabinet Minister has stated that the country may have to spend about half its entire income before the war can be brought to a successful conclusion. Nor does he pause to consider or explain what is being done in the Central Empires—how every man, woman, and child in Germany and Austria has been mobilised for war; how the great populations which are at war with us are content to bear deprivation and hardship, consoling themselves by the reflection that, if their lot is hard, it is heavenly compared with that of the soldiers in the field. These considerations are relegated to the background when it is suggested that the working men of England shall "scorn delights and live laborious days" until the war be ended.

Amongst our enemies the people have been taught to believe (howsoever erroneously) that they can win through by sheer industry. Many efforts have been made to teach the same lesson here; and if the worker can only be made to grasp the fact that he is as important a unit as the man in the firing line, we are satisfied that the Government need bring no pressure to bear in the form of compulsion. Great things have already been done; old England, which the Germans thought incapable of waging a war with her population, has already to a large extent proved the contrary. The vast majority of the working men are doing their share in the field and at the bench; it only remains for the minority to abandon their private interests in the interest of their country.

AN INFLUENTIAL APPEAL TO THE GOVERNMENT.

The Guildhall meeting on "Trade and Employment after the War," convened by the Lord Mayor at the suggestion of a number of organisations interested in the subject, and held on Monday last, was a most impressive event. So far as the speeches were concerned, while they were all good, there was nothing either new in their substance or in the desire and determination that they expressed, but the representative character of the gathering cannot fail to carry weight when the enemy hears of the proceedings, nor should it fail to convince our own Government of the necessity for it to adopt, and that without further delay, a very strong policy in regard to after-the-war trade and the problem of employment. We have Mr. Runciman's assurances that by the time the war ends very complete measures will be found to be ready for safeguarding the interests of British trade against enemy onslaughts. We welcomed the speeches of the President of the Board of Trade because we thought we recognised therein a very definite and thoroughgoing Government policy. We, however, must not lose sight of the fact that the Board of Trade as it exists to-day is choked with work, and cannot with suitable facility take up the new duties that the situation and traders demand. For instance, the Registration of Firms Bill, which came before the House of Lords last week, had to be turned down, at any rate for the present, almost entirely because the Board of Trade was too busy with other duties to carry out the investigations, etc., that the measure would have involved. Yet almost every business-man has known during these eighteen months of war how great have been the difficulties of obtaining information respecting private firms—whether they were "enemy" businesses or not. The conviction that found expression in Monday's meeting was that the Board of Trade should continue its various duties for the regulation, control, and administration of trade, but that the Government should appoint a new Minister of Commerce to be responsible for the *promotion* and *encouragement* of trade. It was not the desire of the gathering to cast reflections upon the Board of Trade. We can re-echo the sentiments of one of the speakers who said that those who from experience knew the Board of Trade best knew well enough that it was not the officials of the Board who were to blame—it was the organisation, which was compelled to handle such various and vast concerns. What a commentary upon our national conservatism lies in the circumstance that it is more than 46 years ago since the commercial men of the United Kingdom first asked for a Ministry of Commerce! Before the German industrial menace or the Prussian military menace had any bearing in our direction—even before the Franco-German war! Yet since then our business men have appealed to Parliament again and again; the Press, including our own modest selves, have urged, in season and out of season, the necessity for action; and all this time we have been congesting the Board of Trade more and more until, as was truly said on Monday, it is too choked to do all that it ought to be doing for the encouragement of trade in these very important days. We wonder what would have happened had there been a Minister of Commerce in office when the war broke out! He and his department might have been able to settle down at once to deal fully with a unique situation full of splendid opportunity. Perhaps, if we dare look further back, we should have had, even before the war, such an investigation of our industrial affairs and such an intelligent grasp of the dangers that threatened, that we should have been better prepared in connection with those "key" industries upon which we are now promised a report.

However, vain regrets will not assist us; resolutions for timely reform are more to the point, and Government action following those resolutions is what we must look for. Reflections on the Board of Trade and the saying of stupid and bitter things about the Department and about Ministers are peculiarly unsuited to the present situation. Other means are more likely to be successful, and we are glad that the Guildhall meeting suffered no loss of dignity in its utterances. The object of the gathering was to show a united front to the enemy and to tender a united appeal to the Government. It is difficult to convey an adequate idea of the importance of the gathering; perhaps we can best do so by stating that there were present seven lord mayors, 70 mayors, representatives of 51 Chambers of Commerce, and 89 trade and industrial associations, eleven High Commissioners and Agents from the other parts of the Empire, ten banks, and many others representing all phases of commercial and public life.

In the course of the speeches, though detail was avoided, reference was made to the need for reforming the consular service—paying consuls well and allowing them a bonus upon the increased trade of the place under their care—the need for educational (technical and commercial) reform and for the extension of commercial banking, and so on—all subjects which have been done to death in the Press, but have perhaps never before been expressed in a public gathering which had such force and authority behind it. The Lord Mayor, in opening the pro-

ceedings, said that Mr. Runciman's speech, already referred to, showed that the Government was in a "friendly mood." We hope that that friendly mood will not only permit the Prime Minister to give an appropriate reception to the City's deputation when it goes to lay the meeting's resolutions before him, but that it will rapidly develop into such a zeal in the interests of British industry and trade as will allow the Houses of Parliament to adopt measures for substantially assisting the business world when it again meets its enemy competitors in the trade war.

One of the resolutions adopted by the meeting called for immediate steps to be taken by the Government and by commercial organisations, to ensure co-operative action for the defence and improvement of trade and employment after the war; recommended full discussion of fiscal, legislative, and other steps for meeting the situation: and suggested the establishment of a Ministry of Commerce to carry out a constructive commercial policy for this country. Another resolution urged close co-operation to improve the commercial relations between ourselves, our Colonies, and our Allies, and to prevent Germany ever again acquiring an undue influence upon our trade and employment.

The meeting was not a "Tariff Reform" demonstration, but the speeches of men of eminence, and of totally different shades of thought in normal times, showed that all were now united in the resolve to "smash Germany" commercially, and wished to acquaint the enemy with that determination of our Empire.

Germany's Submarine Cables After the War.

The important question of the fate of the submarine cable system of Germany after the war has just been raised by a French contemporary, which also refers to one or two interesting matters of past history. It is first pointed out that what can be considered to be one of the vital points of Germany is situated about 25 miles distant from Emden, namely, the island of Borkum, where begin most of the submarine cables which connect—or which connected until they were cut by Great Britain—the Empire with the world. But this opportune destruction of the cables, in the opinion of the French newspaper, will not be solely a war measure, as it rests with the Allies whether the network shall be reconstituted. This depends upon France above all others. During the course of the 15 years which preceded the present conflict, France gave proof of incomprehensible incoherence from this point of view. Whilst politically the country was practising with complete loyalty the Franco-British understanding, telegraphically if it can be so expressed, a Franco-German understanding was being established, which was so obliging on the part of the French that Prince Bulow in 1912 saw in it a reason for hoping for something better. M. Charles Lesage, inspecteur des finances, narrated in a recent work the extraordinary advantage of the South American Cable Co., a British company which, he says, only had a single shareholder—the French Republic—and whose concession was sold by this improvident shareholder to the German South American Telegraph Co. Germany lacked a submarine connection between the Coast of Africa and Pernambuco; she acquired it in this way at little expense. Not only so, but the matter of the cable to the Azores, although still older, is none the less sad. It appears that Portugal at first refused to grant landing rights to the Germans for a cable which would have been an extension of that from Vigo, but finally a concession was given to the Felten & Guilleaume Co. In this way a French company which held an earlier concession, found itself turned out. These incidents are pointed out in order to prevent any future relapse. M. Lesage states in this connection that if in the dogma of Germanism there were not perceived the principles of universal domination, the assistance rendered by other nations to the German Empire in executing their plan of submarine telegraphy would not be regretted. But German Imperialism has become a fetish, and like all fanaticisms, it wishes to conquer in order to enslave. The French newspaper concludes that the world will only really be liberated if the network at Borkum is not re-established, or at least if it is reformed only under the control of the victorious Allies.

Lead.

There has been no substantial alteration in the position of the lead market. The scarcity of supplies available for disposal renders the market exceedingly tight, and buyers have manifested no new interest in the article, while there seems little chance of any radical change in the fundamental conditions for months to come. The main difficulty is, of course, the shipping situation which appears to become more and more aggravated from week to week. It should surely be possible, by the exercise of elementary foresight, to prevent vessels which reach this country to discharge cargoes having to wait for weeks on end before they can get a berth, and commence discharging. The utter futility indeed of the labour policy of the authorities of this country is more responsible than anything else for the rise of prices of all commodities. Meantime, the equanimity with which the shipping interests in the House of Commons and outside seem to regard the state of affairs, which has been brought about by official incompetence augurs ill for any remedial action which may be planned having practical effect. If vessels could discharge their cargoes and get out to sea again without the wholly unreasonable delay at present entailed, there would be a 50 per cent. drop in freight rates. Not only does the congestion here, arising from preventible causes, complicate matters, but it at the same time prevents shipments of fuel from the United Kingdom to Spain, and thus further retards the production of lead at its source. America has lately been selling a little more freely, but here again the shipping question presents an apparently insoluble problem to the powers that be. The leading brokers state that many thousands of tons of lead delivered for shipment to Archangel in the late months of last year will not reach that port until navigation is reopened. It seems almost incredible that the bungling and blundering which characterised 1914 and 1915 can still be running riot. Meanwhile, a tight finger is being held upon the trade, and the authorities have given due warning that if any speculative movement develops they will place lead under the Defence of the Realm Act, a proceeding which would entirely stop all market business. It is very doubtful whether the speculation carried on in lead during the last few months deserves any notice whatever, but if it does, effectual steps have certainly been taken to repress such undesirable transactions.

The Wire-Drawing Industries.

The abnormally high price of electrolytic copper has resulted, as was in some measure to be expected, in a slight easing-off in the demands on copper wire and strip manufacturers recently. The War Office and Admiralty requirements, however, continue to be heavy, and there is not much likelihood of a lessening in demands in this section as regards the immediate future. In the export section the increased licensing difficulties, and the transport problem, have, between them, made it almost impossible to look adequately after the interests of regular overseas customers. The securing of export trade hitherto done by German wire manufacturers has, consequently, proved practically out of the question; but we are informed that the subject of German competition after the war is receiving the most careful attention of British wire manufacturers, and it is hoped that the German firms will find, when the war is over, that their former success in this country, and in overseas markets, will not easily be repeated.

The High-Conductive Copper Association, which comprises many of the most important copper wire manufacturing firms in the country, has in the past considered it not worth the expense and competitive sacrifice to root out the growing menace of German undercutting and subsidisation, as, in order to do so, it would have had to resort to similar questionable tactics.

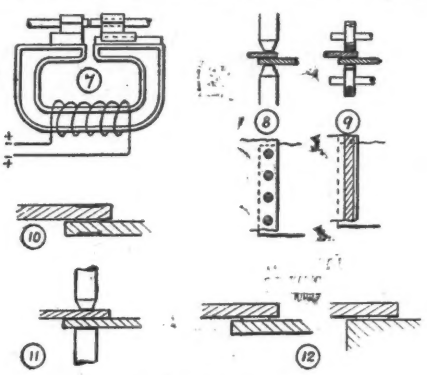
NOTES ON ELECTRIC WELDING PRACTICE.

(*Continued from page* 92.)

Resistance Welding.—Resistance welding is not autogenous in nature. The pieces to be welded are held together in the desired position and a heavy current is passed through the contact. Heat is thus generated in the plane of the joint itself, and directly welding temperature is reached additional mechanical pressure is applied to complete the union and current is simultaneously cut off. Though the necessary current density is high, the voltage required to produce it is low, so that A.C. supply is used for economy, and the transformer forms an integral part of all modern welding machines, the welding jaws being mounted on the ends of a single-turn "secondary" casting, on one limb of which the primary is wound (fig. 7).

The uniform production of heat right across the joint is a very important advantage, and this of all welding processes is the one most easily adapted to machine operation by unskilled labour—it is essentially a *manufacturing* process, and is applicable to almost every metal and pair of metals used in practice, and to sections ranging from 15 sq. in. or more of steel down to wires of 1-16 in. or less diameter (though such small sections can frequently be treated more advantageously by percussive welding). Resistance welders up to 200 or 300 KW. capacity are used in rail welding.

The welding of copper and aluminium, so frequently required in electrical work, can only be performed



FIGS. 7. 8, 9, 10, 11 AND 12.

satisfactorily by electrical methods. The difficulty is, of course, that aluminium, copper, and brass are molten at welding heat, and very susceptible to oxidation. Butt welding by its rapid action gives no time for any considerable degree of oxidation to occur, and the mechanical action of the welding machine ensures that the joint is completed and cooling commenced directly after welding heat is attained; also that oxide or other foreign material in the joint is expelled at the moment of "closing."

For maximum quantitative and qualitative results, the weld should be closed automatically both in respect of time and force. At various dates and for various purposes and metals, hand gear, dead weight, balance arm, spring-operated and hydraulic mechanism has been used to provide the "upsetting" force in butt welding machines. Automatic spring closing gear is useful for small sections and for copper and aluminium, which must be upset just at the right moment and in the right manner; also for zinc and lead, which are not incandescent at welding heat, and hence cannot easily be judged as regards the correct closing temperature and force. Hand closing is quite suitable for most metals between ¼ in. and 1 in. diameter, and hydraulic gear is necessary for large sections. The closing pressure necessary is about 600 lb. per square inch for copper, twice as much for mild steel or wrought iron, and three times as much for tool steels.

By maintaining considerable closing pressure during relatively slow heating by moderate current, there can be formed a weld with a practically smooth bulge or "upset" which in many cases need not be removed. On the other hand, by just maintaining contact pressure and passing a heavier current, metal in the vicinity of the joint is quickly brought to welding heat, and additional closing force being then applied suddenly, there is produced a ragged fin which must generally be ground smooth. The second or "flash" method is safest for metals liable to burning or oxidation, since metal at the contact is forced out at the moment of closing; this method is alone applicable to such metals as aluminium, and though the current consumed is heavier the welding time is shortened and less of the stock metal is taken up in the weld.

There is no fundamental difference between Thomson's first "nutcracker" welder (with a clamp on each leg and the weld where the nut would be) and the latest types of butt welders, but the latter are much more efficacious, due to mechanical improvements such as parallel jaw slides, quicker setting and clamping, and more complete control to suit all classes of work, particularly repetition work. The commercial success of the butt welder may be dated from the time when it was realised that it should be designed and used as a specialised machine tool.

Though the simplest butt welding operation is to join two initially distinct pieces together end to end, even small hoops or links can be butt welded (though with increased current consumption), notwithstanding the short-circuit provided by the continuous part of the work. There are also many special cases of butt welding two distinct pieces which demand special attention to the arrangement of the current-carrying clamping jaws and, in some cases, to preheating. Valuable applications of butt welding pieces at an angle are to be found in building up all kinds of metal frame, rod and strip work; and among miscellaneous operations often involving angle welding and the union of pieces of very different sections, but resulting in satisfactory construction and material manufacturing economy, may be noted butt welding of heads on to bolts, footplates on to pedal levers, rods on to disks to form gear blanks, pole shoes on to magnet cores, flanges on pipes, and metal handles on knives and forks (fig. 26).

Spot and Seam Welding.—Both spot and seam welds are of essentially the same nature as butt welds, but can often be applied where the latter is unsuitable, as, for instance, in building up thin sheet goods. For both spot and seam welds, one piece is lapped over the other and welded together *either* at intervals (fig. 8) by nipping between circular electrodes (thus producing the equivalent of rivets), *or* continuously (fig. 9) by passage between roller electrodes. Mechanical pressure or an intermediate filling disk or strip is depended on to concentrate heating; the second method being the more effective and the first the simpler. Current supply is again through a step-down transformer with single-twin secondary.

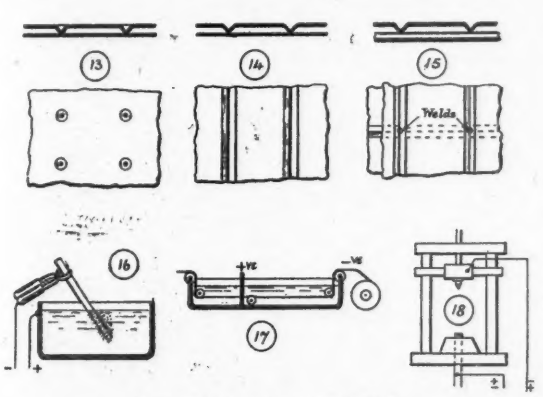
As compared with riveted joints, spot welds do not loosen or tear, but are actually a source of added strength. Generally the electrodes leave a distinct depression (some of the metal tending to flow sideways between the plates and hold them slightly apart, as exaggerated, fig. 10); a larger electrode on one side (fig. 11) generally prevents any depression showing there, and to keep both sides at the original level a "filling-disk" of metal may be inserted before welding (fig. 12). A filling disk to serve this purpose and to concentrate heat at the welding spot is specially desirable when welding thick sheets or attaching sheet to solid parts. Another alternative, often desirable, is to weld a dummy rivet head on one or both sides of the joint at the same time that the spot weld itself is made. The strength of the joint

is entirely in the weld. In passing, it may be noted that a spot-welder (which is simply a butt welder with electrodes and general arrangement adapted to the work in hand) can be used to heat and close ordinary rivets if desired. The resistance surfaces are then at top and bottom of the rivet blank, consequently most heat is developed just where maximum mechanical deformation (for head-forming) is required. The process is silent, and it is easy to secure correct thermal and mechanical conditions during closing.

A spot (or seam) welding machine is easily applicable to a great variety of work, including much that could not be dealt with practically by ordinary butt welding. On spot welding galvanised iron, the zinc coating volatilises from the welding contact, thus ensuring a true iron to iron weld without affecting the protective coating beyond the joint. There is no action, however, comparable with the "upsetting" of a butt weld in its displacement of dirt or oxide from the welding surfaces, so that it is necessary to have the latter clean to ensure a sound joint, and also to prevent abnormal contact resistance which, when it breaks down, permits a rush of current burning the work and electrodes.

For repetition work in hardware construction and other light work it is easy to design a nearly or quite automatic spot or seam welder with motor-operated moving parts. Four or five times the output obtainable with riveting (say 15 to 20 spot welds, or 3 ft. or so of seam weld per minute in light work) can generally be relied upon.

A special variety of spot welding is obtained by forming dents in a thin sheet (using a blunt punch) and then resting this sheet, on the apices of its dents, on a flat sheet (fig. 13), after which the two are



FIGS. 13, 14, 15, 16, 17 AND 18.

welded together by current passing from one to the other. Using large electrodes, a number of welds may be completed at a time. Alternatively, one sheet or both may have ridges rolled in them in the form of shallow corrugations, line welds (fig. 14) or point welds at the crossings of corrugations (fig. 15) being thus formed. If desired, the dents or corrugations may be so shallow as to be flattened in the process of welding, this being an arrangement alternative to the use of filling disks.

The methods mentioned in the last paragraph may be used to build double sheet air-casings for stoves, etc., sheet metal pulleys, and, in fact, any parts requiring sheets in close contact or a short distance apart. Current being concentrated at the welding points the process is rapid and economical.

Electrolytic Welding.—The Hohe electrolytic welding process is interesting, but not, so far as the writer is aware, of any great practical importance. The work to be heated is connected as kathode (or held in tongs with insulated handle) in an electrolytic vat (fig. 16) which may have a special anode plate or be itself the anode. The electrolyte may be diluted sulphuric acid; a solution of sodium carbonate; a solution of borax and potassium carbonate; or a solution of sodium and potassium chlorides and carbonates. The only requirements are that it be a low resistance electrolyte and yield hydrogen on electrolysis. The heating vat is connected in a 100-200-volt circuit, and the work rapidly becomes coated with a layer of gas bubbles which offer such resistance that white heat is easily attained. The process is, however, only a heating process, and welding is supposed to be done on an anvil, so that the method is practically limited to wrought iron and mild steel.

Obviously there is necessarily considerable loss of heat, to the detriment of efficiency. The most useful application of the method appears to be to annealing and tempering—either rods, tools or wire. The work is heated as above, and quenched simply by cutting off current altogether, or, in the case of wire, by passing the latter beyond the current-carrying zone (as shown in diagram, fig. 17). Whilst hot, the work is encased in a film of reducing gas, so that scaling and blistering is impossible.

Electropercussive Welding.—The electropercussive system of welding invented, or rather discovered, about ten years ago by Chubb, possesses many unique features. The explosive discharge of a large electrolytic condenser is used to fuse the contiguous surfaces of pieces to be joined, and the weld is then completed by the momentum of one piece, which is moving rapidly by the time it reaches the other and completes the condenser discharge circuit.

Due to the *extremely* local nature of the heating and the explosive violence of the electrical discharge which blows out oxide, etc., from the weld, reliable joints can be produced between practically any pair of metals, irrespective of difference in thermal conductivity, melting point and liability to oxidation. Local heating as ordinarily understood, as produced, for instance, by arc welding, is liable to set up severe thermo-mechanical stresses, but the heating produced by electropercussive welding is so intensely local that no more than a film of metal is affected. Extremely intimate contact is secured in the film, so that the union is satisfactory, but the thickness of weld metal is so small that it makes no appreciable difference whether it be soft, hard, or even a brittle alloy. The whole thickness of metal heated to any considerable degree is of the order of two or three-thousandths of an inch. Practically, the method gives cold welding with all the advantages and none of the disadvantages of autogenous welding at the actual joint.

In its most successful form the electropercussive welding machine is built as a miniature pile driver (fig. 18), the "monkey" being the moving contact jaw carrying one of the pieces to be welded. Welding can be done at a distance (50 ft. or more if necessary) from the condenser and charging generator. Pre-eminently, the method is useful for welding small wires (1-16 in. diameter or less) together or on to plates; for attaching platinum contacts to screws and springs; for building thermo-couples and other light work which cannot be done easily or at all by other means. If found desirable, the method can doubtless be extended to heavier applications.

Light load losses in the condenser charging set constitute the chief item of power expenditure. Some tens of kilowatts may be operative in the weld at the moment of discharge, but as the discharge lasts somewhere about one-thousandth of a second the effect produced is absolutely local, and the actual energy consumption is almost negligible; conduction and radiation losses are nil. An application of particular interest and importance to the electrical engineer is the welding of copper to aluminium—whether in field coil leads or strand by strand in cables; in the latter event, a copper insert suitably protected against electrolysis, forms an excellent method of interconnecting two aluminium lines.

(*To be continued.*)

A LABORATORY FOR RESEARCH ON HEATING AND VENTILATION.

Whilst the lighting of buildings has received a vast amount of attention, and has given rise to innumerable researches, the allied subjects of heating and ventilation in relation to the well-being of the inmates of public and private buildings have notoriously been neglected, even by architects, who, we should think, of all professional men, ought to have studied exhaustively matters of so great and personal moment to their clients. Only within quite recent years, as we pointed out not long ago, has this wide field for investigation been invaded with the aid of scientific method, and there are still very few workers engaged in the assault upon these admittedly difficult problems, although the results already obtained are so interesting and unexpected that they should attract the attention of all who are concerned with the erection of buildings, and the manufacture of the appliances used for heating and ventilating them.

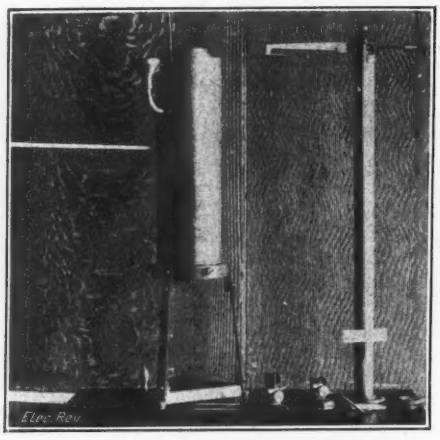


Fig. 1.—Apparatus for Measuring the True Temperature of the Air.

Fig. 2.—Apparatus for Measuring Convection and Radiation.

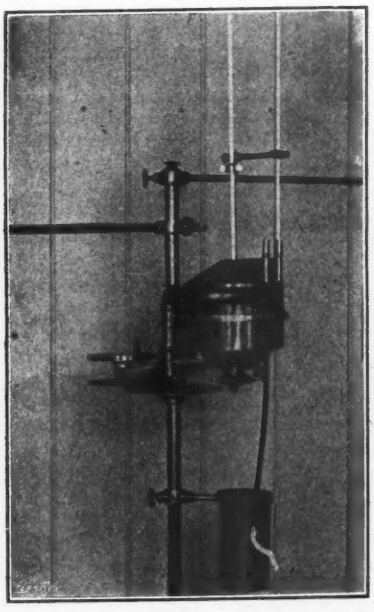


Fig. 3.—Apparatus for Measuring Radiation Temperature.

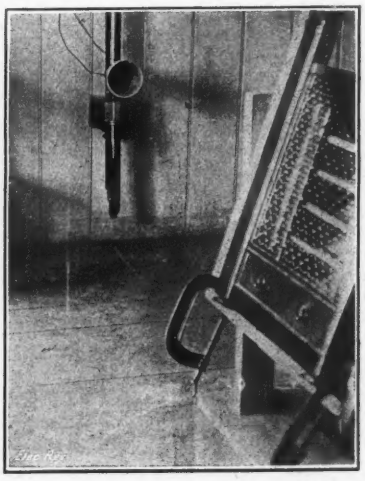


Fig. 4.—Thermopile fixed on Wall; Radiator Mounted on Cradle.

In our issue of December 17th we published an abstract of an address delivered at University College by Prof. A. H. Barker, one of the few investigators who have tackled the subject with determination and enthusiasm, and we were recently privileged to pay a visit to his laboratory and to be initiated into the mysteries of the science which he has made his own. The laboratory is situated close to University College, Gower Street, no room being available within the precincts, but in all probability accommodation will eventually be provided at the College itself, for the value and importance of the investigations which have been carried on in the temporary laboratory, under very great difficulties, have been appreciated by the authorities; in fact, a new department of heating and ventilation has been created as the direct outcome of this work, and Prof. Barker has been appointed the first lecturer, as was his due. The Institution of Heating Engineers has given valuable support to the new departure by supplying research students and in other ways.

In the address above mentioned, Mr. Barker explained how he had succeeded in separating the apparent temperature of the air in a room, as indicated by a thermometer, into two component parts—one, the *true* temperature of the air, the other the effect of radiation to the thermometer from the walls and furniture of the room. The problem was one of exceptional difficulty, but has now been thoroughly analysed and solved, with the aid of instruments devised by Mr. Barker for the purpose.

In the first place, the true temperature of the air is ascertained by varying the temperature of a column of air in a vertical tube by means of a water-jacket until the density of the air inside the tube is the same as that of the room; when this is not the case, the air in the tube will either rise or fall, and to detect the existence of such a current a delicately suspended diaphragm, nearly filling the top of the tube, was employed (fig. 1). When all is steady, and the detector shows that there is no current of air up or down, the temperature of the air inside the tube as read by a specially calibrated and shielded thermometer is the true temperature of the air in the room.

To determine the "radiant temperature" a somewhat similar apparatus is used (fig. 3), but in this case the temperature of the water-jacket is raised or lowered as may be necessary, with continual stirring, until the reading of a thermometer within it is the same as that of a thermometer suspended in the surrounding air, when the temperature of the jacket

water represents the average temperature of the surfaces radiating heat to the thermometer; obviously this measurement is affected by the position of the external thermometer with regard to its surroundings, when the latter are not at a uniform temperature—near a cold window, for instance, the mean radiant temperature will be lowered—and this effect has been carefully studied. An approximation to the true air temperature can be obtained by surrounding a thermometer with a specially designed vacuum jacket on the Thermos principle, which cuts off practically all radiant heat, and this has greatly simplified the work. Experiments are now in progress with a view to obtaining an equally simple means of arriving at the radiant temperature, by the use of thermometers with large bulbs, which are warmed up and then allowed to cool, the rate of cooling being a function, *inter alia*, of the amount of radiation.

An elaborate investigation of the conditions obtaining in the House of Commons, one of the most

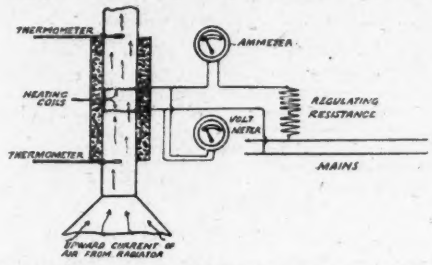


Fig. 5.—Method of Measuring Convected Heat.

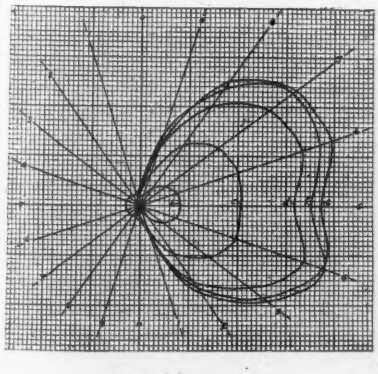
adequately heated and ventilated chambers in the world, but a very uncomfortable one nevertheless, was performed by Prof. Leonard Hill and Mr. Barker with water-jacketed apparatus of the type above described, and their recommendations were on the point of being carried out when the outbreak of war necessitated the postponement of the work.

The bearing of such investigations on the design and application of electric radiators was explained in the address to which we have referred; briefly, it was shown that for occasional use a radiator was preferable to a convector, and that with radiant heat supplied, the occupants of the room might be perfectly comfortable although the "temperature of the room," as indicated by a thermometer, was even below 50° Fahrenheit. In connection with this subject Prof. Barker undertook an investigation of the performance of electric radiators, by measuring the amounts of heat evolved respectively by radiation and by convection. This research involved the construction of a variety of special apparatus.

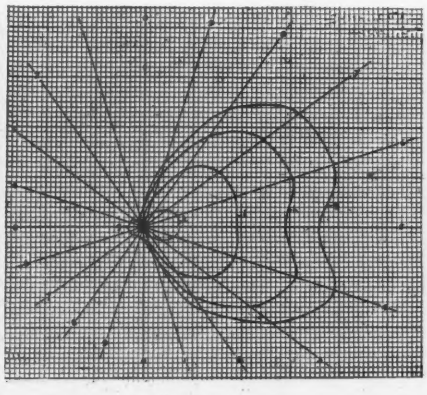
In order to capture all the hot air rising from the heating apparatus, a kind of hood, or cowl, was devised, in the shape of a well-lagged pyramid, to the apex of which a flue was attached (fig. 2); to ensure that no eddies should escape capture, it was found necessary to draw air gently through the flue with an electric fan. To measure the rate of flow of the air, a grid of resistance wires was fixed in the flue and supplied with sufficient electrical energy at a known rate to keep its temperature slightly above that of the air current. The arrangement is indicated diagrammatically in fig. 5. By measuring the temperature of the air below and above the grid, knowing the specific heat of the air and the rate of dissipation of energy by the grid, the rate of flow of the air could be accurately determined, and the amount of heat energy which it received from the radiator could then be ascertained, the true temperature of the surrounding air being known.

To measure the heat radiated in any given direction, an iron bar bent to the arc of a quadrant was fixed with the radiator at its centre, and a movable device for measuring the radiant heat was attached to the arc, as in fig. 2, thus giving readings at all angles in a vertical plane through the radiator; by shifting the arc round the radiator, the radiation at a series of angles in other vertical planes could similarly be measured, and the result was a map of the space surrounding the radiator, showing the intensity of the radiant heat at points on the surface of a sphere of five feet radius—a distance taken as standard in these investigations. The radiation detector first used consisted of an absorber one square foot in area, composed of blackened coils of metal tubing through which water flowed; the temperature of the water at inlet and outlet being measured, and the rate of flow being known, the amount of heat absorbed per second could be determined. This, however, proved to be an excessively tedious and cumbersome method of test, and has been replaced by an electrical method. A thermopile was standardised and substituted for the absorber, and in conjunction with a galvanometer has given the greatest satisfaction as a radiation measuring device. Moreover, to avoid the necessity of moving the thermopile about the radiator, a cradle was made for the latter, by means of which it was made possible to explore the field of radiation by rocking the radiator into various positions whilst keeping the thermopile fixed (fig. 4). Thus a very great improvement in method was achieved. The thermopile was calibrated to give watts per square foot at five feet radius. Unfortunately it is not possible to rock gas radiators about so freely as electric radiators, and consequently the former have to be tested by moving the thermopile and not the radiator.

By means of these arrangements Mr. Barker has been able to account for the whole of the heat developed by a radiator, within two or three per cent., in spite of the obvious difficulties of the work. Many types of electric radiator have been tested exhaustively, and we are indebted to Mr. Barker for the examples of plotting illustrated herewith, as well as for the photographs from which we have reproduced



Left-hand Side, Zones *a* to *f*.



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Figs. 6-7.—Readings in Vertical Planes.

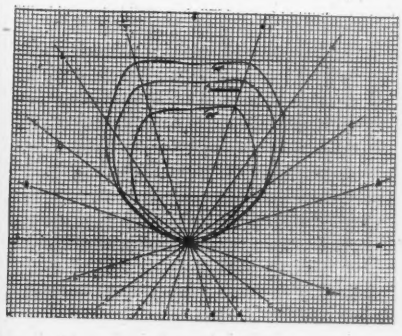


Fig. 8.—Lateral Distribution of Radiation (at angles of 18°, 0°, and 54° with the horizontal plane).

illustrations of his equipment. The latter includes a recording ammeter, and an ingenious attachment to the pointers of an Aron meter to give a closer record of the amount of energy consumed at a given moment than could be read directly from the dials.

In the foregoing account we have only dealt with a portion of the resources of this laboratory, which is equipped also for testing gas and coal fires, a thermostatic arrangement for keeping the temperature of the room constant for long periods, means for testing hot-water radiators and pipes, instruments inserted at various depths in an external wall to obtain the temperature gradient in the body of the wall, an isolated section of the wall provided with a water-jacket and electrical means for determining the rate of loss of heat through it, and a series of wires stretched upon a wall for the purpose of heating the wall electrically for experimental purposes. A system of gauges to show the pressures at various points in a hot-water pipe system, and a micrometer gauging device to measure the rate of flow of water under low heads, have also been devised by Mr. Barker, as well as an elaborate and very sensitive apparatus based upon the principle of the Wheatstone bridge for measuring the resistance of air ducts, cowls, etc,, in terms of definite units. With these our readers are less concerned than with the apparatus described above, but we have said enough to show that the subjects of heating and ventilation are now being dealt with in a manner which promises to elucidate many of the problems with which all civilised peoples are so intimately concerned; and we are glad to record that a British University and a British scientist are the first, we believe, to embark upon the study of these important matters.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The I.E.E. and Alien Enemy Members.

The "Six Borough Electrical Engineers," in their statement of last week, have most ably voiced the feelings of, I am sure, the majority of the members of the I.E.E. on the above subject.

It now only remains for a definite movement to be set on foot to give effect to the principles enunciated, and I would suggest that the six engineers should consent to receive the names of others who are in sympathy with them with a view to supporting a formal notice to the Council, asking for an extraordinary general meeting to be called to deal with the matter.

If members in the various local centres would act simultaneously the whole question could be settled in a very short time. I enclose my card and remain, for the moment,

Alien-ate(r).

I was pleased to see, in last week's issue, the very ably-written letter signed by "Six Borough Electrical Engineers," and to see that irrespective of the "hidden hand influence" which exists, and which has used every endeavour to prevent any action being taken towards the exclusion of members of alien enemy origin, whether naturalised or not, certain members of the Institution do not intend to allow the matter to rest.

As a contrast, one sees from the statement of the President of the Institution that the Council has appointed a committee of Vice-Presidents to consider this question, and still maintains that Article 41 gives it power to deal with it, but that no ten members have yet brought forward a definite charge against any corporate member of the Institution.

It has previously been pointed out that under Clause 80 the Council could have called a general meeting of the Institution members to consider whether any alteration in the by-laws should be made so as to exclude all corporate members who were of alien enemy origin. From the fact of its not having done so, it is clear it is not desirous that these people should be excluded, and, according to information which I have from time to time gathered from people interested in the movement, or who have acted on behalf of associations who have communicated with the Secretary on this point, there is a great lack of sympathy shown, whilst no assistance is afforded at all. There is, further, a rumour that a petition for a deputation and general meeting has been received, but I do not see any public announcement of it.

It is a well-known fact that the Council of the Institution dare not take a plebiscite of the members by ballot through the post on this point, for it knows full well the decision would be whole-hearted exclusion of all alien enemy members, whether naturalised or not.

I think it is viewed, should a general meeting be forced on the Institution, that the movement for the exclusion of such alien enemy members may be killed, either by reason of the lack of members, or the fact that the members then present will be marked men for the future, and, if in commercial houses, their positions may be jeopardised, which would not be the case if a plebiscite were taken.

To think that an institution like the Institution of Electrical Engineers has failed so much in showing a patriotic spirit is, I think, a severe reflection upon its membership. I can only recommend each member of the Council, when considering the exclusion of such members as may be thought worthy of its consideration under Clause 41, personally to read (as the writer has done) the *Appendix to the Report of the Committee on alleged German Outrages presented to Parliament by command of His Majesty*, Cd. 7895; price 1s. 9d. This, I believe, is expurgated, inasmuch as the more revolting and disgusting outrages are not therein referred to (if we can conceive such). I trust that, after having done this, they will realise that the outrages have been committed and authorised by a class of people essentially of the professional class, and of a class equivalent or superior to those members of the Institution referred to, and, further, have been committed by people of the same generation.

I trust, in conclusion, that members will refrain from paying their subscriptions until some definite attitude has been adopted by the Institution, and that the members, as a whole, will have every opportunity of deciding for themselves whether such a policy is right or not, and that such decision will be made in such a manner that they may, without fear of jeopardising their positions, do so.

Station Engineer.

The Problem of the "Point-Five" Tariff.

I have been interested in your communicated article dealing with the above in your issues for October 1st and 8th last. The article is mainly a criticism of the Norwich rating tariff system, also in use in conjunction with the "Point-five" tariff. One would have liked to see a criticism of the equity and the financial soundness of the "Point-five" tariff, and also an alternative to the Norwich system. It is true some suggestion was made that a more consistent system would be one in which the fixed charge was based on an *estimated* maximum demand. This seems likely, however, to have many of the defects that the Norwich system has.

With many others, I have always held the view that the Norwich system was a very crude approximation; in fact, one might as well base the fixed charge on a man's wages or income as on the rating of his house. To base the fixed charge on the actual maximum demand is no doubt the soundest and most consistent method, and the many critics of the "Point-five" enthusiasts would, of course, require that this maximum demand should be based on the total demands for lighting, heating, and cooking combined.

In Australia, owing to the comparatively mild climate and the disadvantages of cooking by ordinary methods during our hot summer months, electricity for heating and cooking should have a particularly good field. Notwithstanding this, there are, I believe, few, if any, engineers out here who favour, or believe in the financial soundness of, the "Point-five" tariff, or a figure in the neighbourhood of this, as a means for tapping this demand. The recent revelations from those undertakings which have had some experience of the "Point-five" tariff will hardly help to advance this system.

Radiators are greatly on the increase in many Australian undertakings, and, although they are only used during a few months of the year, still they have in many cases a better load factor than cooking would have. They have shown, however, that they create a distinct peak of their own, and it is questionable whether they are a payable proposition at prices per unit very considerably higher than the "Point-five" tariff.

The effect of the "Point-five" tariff on the stability of an undertaking can only be judged when the demand has reached large proportions. In the many cases quoted, the units sold on this system bear such a small proportion to the whole that their effect on the peak, and on the capacity of the mains and power station, is but small.

With a tariff in the neighbourhood of the "Point-five," coupled with satisfactory heating and cooking appliances, it is pretty safe to assume that in many of the undertakings at home, lighting, and even power supply, will be altogether secondary to heating and cooking. Those undertakings in which motive power does not predominate must, when this time arrives, find their peak load very seriously affected by the heating and cooking load which is superimposed on their lighting. Where power load predominates, many undertakings find that their peak is in the neighbourhood of noon, and the mid-day heating and cooking load, when fully ad-

vanced, must in consequence create a very decided and important peak of its own.

In your communicated article it would have been interesting to see some consideration given to the Norwich system coupled with the introduction of the half-watt lamp. It has been stated that those who have adopted a fixed-charge system, such as the Norwich, will be in a much better position to face the problem that arises from the introduction of the half-watt lamp than those who have a tariff of a certain price per unit without a fixed charge. This is very questionable. Take the Norwich system coupled with the "Point-five" tariff, and assume that the fixed charge, plus ½d. per unit, is equivalent to 4d. per unit for lighting. If we assume, for argument, that the half-watt lamp halves the consumption, which, fortunately, at present it does not, then on the above tariff the consumer would be paying for his lighting on the equivalent of 3½d. per unit. Those consumers who have not changed over to the Norwich system, such as shops, public buildings, etc., who cannot very well be offered the Norwich system, would, instead of paying the 4d. per unit, be getting their lighting on the equivalent of 2d. per unit. It would, therefore, pay many consumers where cooking and heating units are not a very large item to discard the Norwich system and demand any heating or cooking power they require on the ordinary rates. A great inconsistency would ensue; in fact, very unfair preference might be claimed. Why, for instance, should the shop and many public buildings, who are among our most unremunerative consumers, get their lighting at the equivalent of 2d. per unit, and the private house, which is one of our best consumers, owing to its higher load factor, be charged at the equivalent of 3½d.?

The fixed-rate system with a much higher price per unit would lessen some of the above defects, but where would the "Point-five" tariff be?

The war has, no doubt, delayed the advance of the half-watt lamp, but it is to-day an important factor for shops and public buildings lighting, where the larger units can be employed. It is, however, only a question of time when the same will occur in the case of private house lighting, and then the Norwich system will be faced with many of the same difficulties that other tariffs will have to consider.

The half-watt lamp is bound again to raise the standard of lighting in the same way, but hardly to the same extent, as the metallic-filament lamp did, but this will in all probability not be the case with the majority of our private house consumers. The 16-c.p. standard of carbon-lamp days was, in very many cases, too low, and has been replaced by the 50-c.p. standard. It is hardly conceivable in the case of the majority of private houses, except where indirect or semi-indirect lighting is introduced, that the standard will be raised much beyond 50 c.p. Some alteration in the tariff, to meet the problem which must result from the introduction of the half-watt lamp, seems inevitable, particularly so in those undertakings which to a great extent depend upon lighting for their revenue. Already undertakings are feeling the effect of the half-watt lamp in the case of shops and public buildings, etc. Fortunately private houses, the mainstay of many undertakings, will be little affected in the meantime.

I throw out a suggestion, a crude one, as a result of the above position. Where a shop or public building has the whole of its lighting changed over to half-watt lamps, the ordinary tariffs should be increased by some percentage, say, for argument, 40 per cent. If such a consumer is using high-candle-power units, then his tariff would have to be doubled to bring in the same revenue. The above suggestion would, therefore, concede him 60 per cent. of the advantage, the supply undertaking retaining 40 per cent. If only 75 per cent. of the candle-power installed was with half-watt lamps, then the increase in the tariff would be 30 per cent., and on the same basis 50 per cent., and 25 per cent. would increase the tariff 20 per cent. and 10 per cent. respectively. There would, of course, be some difficulty in checking the above, and when you come to private houses it would be much greater. Perhaps, however, by the time the private-house problem has to be met there will be other solutions of the difficulty. The proposal, I know, is a crude one, and has objections. I simply throw it out in the hope that it may lead to further consideration and discussion of the problem and, perhaps, some solution.

P. J. Pringle.

Ballarat, Victoria, *December 9th*, 1915.

[We may point out that in this country the supply authority is forbidden by law to place any restriction on the type of consuming device adopted by its customers. We have grave doubt as to the practicability of the proposal contained in Mr. Pringle's last paragraph.—Eds. Elec. Rev.]

["Crane" is reminded that letters unaccompanied by the name and address of the writer are not accepted for publication.—Eds. Elec. Rev.]

Russian Chamber of Commerce in London.—The Foreign Office announces that the organisation styled "The Russian Chamber of Commerce in London" has not obtained the recognition or approval of either His Majesty's Government or the Imperial Russian Government.

THE PREDETERMINATION OF THE PERFORMANCE OF DYNAMO-ELECTRIC MACHINERY.

Prof. Miles Walker's paper was discussed by the Manchester Local Section of the Institution of Electrical Engineers on January 11th.

Mr. L. A. H. Carr said regarding leakage that the author's method seemed rather complicated. The speaker had found it possible in practice to calculate leakage by means of a formula containing only two terms, the first being proportional to the core lengths (a different constant being used accordingly as the rotor slots were more or less than the stator slots) and the second giving the end leakage. This method worked well in practice, and the determination of the two constants for any given line of motors was fairly simple. The core loss curves in the paper called for some criticism. Some years ago he had carried out a series of experiments on core losses, and it was found that for a given periodicity and flux density the core loss in a D.C. machine was about double that in an A.C. machine. Regarding the "tailing-off" at the upper end of the curves, he had observed this effect in asynchronous machines with cylindrical rotors. It did not occur, however, in D.C. machines, even with extremely high apparent tooth densities, the curves taking in fact an increased upward tendency. The equation for watts dissipated from a cylindrical surface seemed much too high for an induction motor, but gave good results for D.C. machines with relatively large air spaces between the salient poles. He gave figures to disprove the possibility of getting enough air through a narrow induction-motor air-gap in order to dissipate the quantity of heat mentioned.

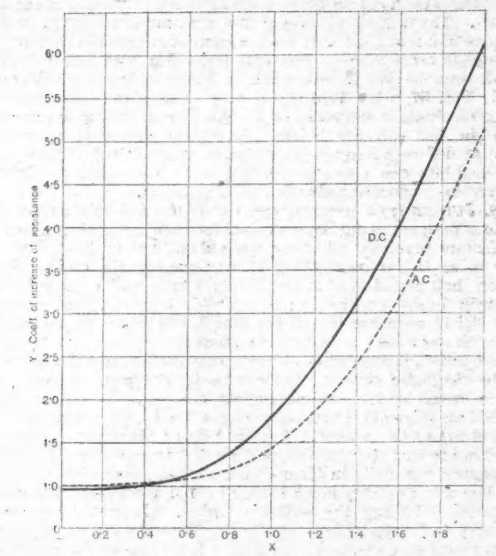
Mr. Julius Frith said the current loading was surely quite as important as the flux loading, also the ratio of flux loading to current loading. The method of taking the maximum induction in the air-space and multiplying it by the maximum possible area of the air-space in order to get a fictitious large flux was not inviting. In reference to Mr. Field's work, a Manchester paper (*Journal*, I.E.E., Vol. 37, page 101), gave very good curves showing the increased ohmic resistance due to the current being forced outwards in the slot conductors. The four curves showing iron losses at different frequencies could, with sufficient accuracy, be combined into one curve by plotting watts per cubic centimetre against the product of induction and frequency.

Mr. Juhlin from personal experience testified to the ease with which a designer could lay out machines and get a clear grasp of the factors involved, using the method outlined by Prof. Walker; after using it for some time, it was exceedingly quick. Prof. Walker had stated that it was hardly worth while to calculate the iron losses accurately; it seemed, however, that without some fairly accurate idea of the iron losses it was impossible to deal with one of the main headings, namely, temperature rise, and, in his opinion, it was desirable to allocate the loss to different parts of the magnetic circuit. The curves in the paper appeared to give a result which was altogether too low. The losses in a finished machine did not by any means lie in the lamination, as pointed out by the author. A great part of these losses would be found in the iron structure supporting the laminations and also in the copper, especially in direct-current machines at high densities. The loss was probably much higher in D.C. machines than would be calculated using the author's curves. It would also seem necessary to discriminate between the losses in induction motors and turbo-alternators, and the field for investigation in this work was very great indeed. The eddy-current losses increased very rapidly with the working of the iron. For example, in turbo-alternators there was a big mass of unworked iron, whereas in induction motors with a large number of slots the worked surface was considerable, and the losses were consequently high. The same remarks applied to direct-current machines.

Mr. R. E. Grime said that a special sheet for each type of machine would be preferable; three such sheets would fulfil most purposes. The author had given prime importance to what might be described as "frame constants," *i.e.*, the idealised total magnetic flux ϕ crossing the air-gap $A_g B$, and the total ampere-turns $I_a Z_a$; the speaker entered a plea for the utility of *specific* magnetic and electrical loadings, especially in preliminary calculations. The specific magnetic loading was the average air-gap induction round the whole machine; denoting this by B_{av} it equalled $2 p \phi / 2 \pi rl$. The specific electric loading equalled ($I_a Z_a$/circumference), and was often denoted by q. These two quantities had the great advantage that for a given type of machine they remained sufficiently constant over a wide range of frame sizes. After some experience with these constants a designer could usually estimate what values to aim at, and make the constants the basis of the first tentative design. The output coefficient given by the $D^2 l$ formula on design sheets always appeared rather a blind way of estimating what use was being made of available space and material. This coefficient was inversely proportional to the product $B_{av} \times q$. For example, in a continuous-current machine, after allowing for internal resistance drop the $D^2 l$ formula might be written $KW./R\,P.M. = D^2 l \times B_{av} \times q \times \pi^2/6 \times 10^{12}$. This expression, which was quite familiar, merely brought out the fact that whereas the ordinary output coefficient was often used to indicate that it was possible to put a given output into certain dimensions, if this coefficient was replaced by the two quantities B_{av} and q, the designer would see at once how it was possible to get it into those dimensions. It was obvious that the air-gap induction B might be used instead of the average value at the discretion of the designer, as the author's field-form coefficient K_f was simply the ratio of these

D

two quantities, *i.e.*, $B_{av} = K_1 B$. The product $q\Delta$ of specific electric loading by current density in armature copper often gave a very close idea of the temperature rise of standard machines; it was something more than an empirical rule, as it was proportional to the copper loss per cm. of air-gap area, and also in the case of a barrel winding, per cm.^{2} of end-connection cooling surface. Thus for a given continuous-current frame of practically constant flux a curve could be plotted showing the relation between the permissible value of the product $q\Delta$ and the peripheral speed, and over quite a wide range of frame sizes this curve remained practically the same. In a line of standard machines of one type, therefore, such a curve, when once determined, gave instantly a fairly close indication of the current density to be employed in connection with any proposed value of the specific current loading. The observed total iron loss was usually considerably higher than that indicated by the curves. In induction motors and alternators the losses generally increased approximately as the square of the total flux, while in D.C. machines the index was usually 2·5 to 2·8, or even higher, at a very high tooth induction. The difficulties in the way of forming a reliable estimate of the extra losses were so great, especially in view of the large difference produced by small shop variations, that the allowance for them must remain mainly empirical. The stray losses, which were dependent upon the load, were mainly accounted for by (*a*) eddy-current losses in the conductors embedded in the slots, and (*b*) additional iron loss due to distortion of field-form by armature reaction. In the armature conductors of D.C. machines, owing to the almost rectangular shape of the current wave form, the effective increase in resistance was considerably greater than when the same conductor carried a sinusoidal alternating current. The curve A.C. in the accompanying figure gave the mean coefficient of increase of resistance for the top and bottom conductors of an ordinary barrel winding carrying a sinusoidal current; the curve D.C. showed the corresponding effect in a normal D.C. winding.



EQUIVALENT INCREASE OF RESISTANCE OF EMBEDDED COPPER OF STANDARD TWO-LAYER WINDING.

Y = coefficient of increase of resistance (mean of top and bottom conductors).
X = 0·14 × depth of conductor in cm.
× $\sqrt{\text{frequency}}$ × width of conductors, total / width of slot.
for copper at 60° C.

For simplicity the curves showed only the mean increase in top and bottom conductors, assuming these to be identical in size. The stray iron losses on load were not so amenable to calculation, owing to the awkward shape of the field-form. It was possible, however, by ignoring the field-form altogether, and simply considering the maximum induction under the trailing-pole tips (of a generator) to arrive quickly at a result which was, at least, of the right order of magnitude.

MR. R. TOWNSEND said that after 10 years' experience of Prof. Walker's method he preferred it to the method generally adopted. The constant K, might seem rather complicated, but after a little use it was quite simple, and once obtained for a given frame it was practically constant irrespective of the number of slots per pole. The great advantage of using the constant was that it conveyed so much meaning in one figure and showed at a glance whether the best results were being obtained from any particular design of frame. The adoption of one calculation sheet for all machines was not desirable. For example, if a designer had been working on alternator designs for some time and suddenly turned to D.C. machines, it was quite easy to overlook the fact that in one case a certain portion of the tooth depth had to be added to the armature diameter, and in the other a certain portion had to be subtracted. A separate type of design sheet would certainly tend to prevent mistakes of this kind; in fact, sheets having a different colour would be preferable.

MR. W. E. M. AYRES said he had found it very useful, in the calculation of the magnetising current for induction motors, to plot curves for the magnetising current in terms of the air-gap plotted against flux densities for different parts of the magnetic circuit. Regarding the curves for iron losses which, presumably, were for A.C. machinery, he had not found the actual losses tapering off so much at high densities. The use of the same curves for losses in teeth and core was frequently insufficiently accurate owing to the fact that the core was usually substantial unworked iron, while round the slot was considerably worked iron. The estimation of the heating of induction motors was a very complicated matter. Cases had been observed where a reduction of rotor losses had resulted in cooler stator iron, although the stator iron losses had increased. The heating of the stator could be considerably modified by taking the heat away from the end connections in an efficient manner. Taking the ampere wires per unit length of periphery as the current loading, and air-gap flux density per unit area as the magnetic loading for any machine, the product of these values multiplied by $D^2 l$ was a measure of the output, and a glance at such figures was sufficient to indicate to an experienced person how the machine was loaded.

PROF. MILES WALKER, in a brief reply, said that he did not agree with Mr. Carr's suggestion regarding the correct method of calculating the leakage of induction motors. The calculation should be made as simple as possible, but the designer should have before him the principal factors which determined the amount of leakage. The iron loss curves, which had been subjected to considerable criticism, were intended to represent the legitimate iron losses. Reasons were given in the paper why some of the so-called iron losses were actually higher in practice, but the author did not consider it right to accept these additional losses as something inevitable and put them into the curves for general application. The correct procedure was to give curves for the legitimate iron losses, and if there was a legitimate loss, say due to eddy currents in conductors occurring when the teeth became saturated, a separate small formula should be employed to take care of it. He was quite sure that the legitimate iron losses would follow a curve as given in the paper. The author agreed that the teeth and core losses should be separated and the individual curves plotted. The importance of the iron losses was enormously great, and the temperature rise of a machine could not be estimated without a fair knowledge of these losses. For some reasons it was probably better to adopt separate design sheets, but it was well to have one general method of design.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Glass Wool.

Amongst the new industries that have been established within our borders as a result of the war, is the manufacture of glass wool. This useful substance is now made in London with British labour by the BRITISH GLASS WOOL CO., 134A, Holloway Road, London, N.; moreover, it is not made under foreign patents, but by an electrical method invented and developed by the firm, and the product is so fine, soft and brilliant that it can hardly be distinguished in appearance from silk—it is difficult to realise that it consists of glass. Makers of cookers, electric furnaces, portable accumulators and similar articles will no doubt be interested in the material, and we should think that many other classes of manufacturer would find it useful.

Salt-Water Leakage in Surface Condensers.

When salt water is used for circulating purposes in connection with surface condensers, there is always the possibility of contaminating the condensate because of leakage of the condenser tubes or packing. This leakage is usually detected by chemical tests of the condensate. The following electrical method of determining leakage has as its basis the measurement of the potential drop in a circuit. Referring to the illustration, an ordinary spark plug is screwed into the condensate pipe as near

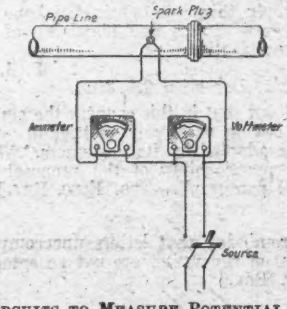


FIG. 1.—CIRCUITS TO MEASURE POTENTIAL DROP ACROSS GAP OF SPARK PLUG.

the base or hot-well of the condenser as possible. Across the two leads to this spark plug a voltmeter is connected, and an ammeter is placed in the circuit as shown. Assuming no leakage, pure water will flow across the gap of the spark plug and offer a high resistance to the flow of the current. This condition results in a

high potential drop across the gap. As leakage occurs the resistance decreases, and the drop becomes less also, affecting the flow of current.

By a little experimentation the resistance of various states of the water from pure to rank contamination may be computed by Ohm's law and the results recorded. In actual operation the oiler may read the instruments and record the data on his log sheets. When these are turned in, it requires but a few minutes' work to determine the condition of the condenser as regards leakage.—*Electrical World.*

An X-Ray Portable Power Plant.

It is probably safe to say that at no time since its first application to medical science has the X-ray played so important a part as it is doing at the present time in connection with the work of saving the lives of wounded soldiers, who, but for the prompt diagnosis it permits, would succumb to their wounds. Not only are all the military hospitals equipped with such apparatus, but a large number of travelling hospitals in the form of specially-designed motor vehicles are also being used near the field of battle by the Medical Service of the Army. One of the needs that the war early brought about in connection with the use of the X-ray was that of a portable power plant which could be quickly installed either in a motor vehicle or in hospitals not

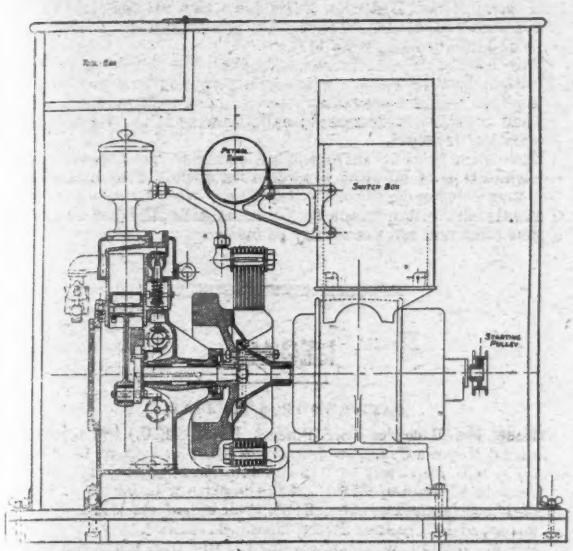


Fig. 2.—Sectional View of Austin Portable Power Plant.

provided with a source of electrical energy, and we are this week able to illustrate the compact little set which the Austin Motor Co., Ltd., of Northfield, Birmingham, specially designed for this work, and of which they have supplied a large number to the Director-General of Army Medical Service.

The set, which is exceedingly compact, occupying a space of only 3 ft. by 2 ft. by 3 ft., comprises a single-cylinder petrol engine

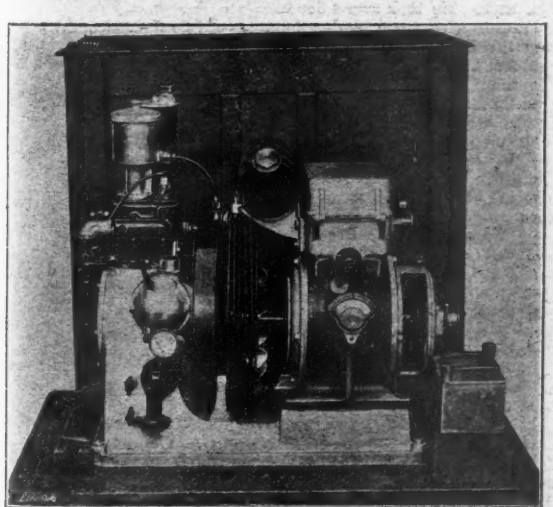


Fig. 3.—Austin X-Ray Portable Power Plant.

developing 1½ h.p. at a speed of 1,300 r.p.m. radiator, silencer, petrol tank, dynamo and switchbox, the whole, for portable purposes, being enclosed in a wooden box provided with carrying handles and also with a receptacle for the necessary tools.

So far as the engine, which has a bore and stroke of 2½ × 3 in., is concerned, this calls for no special description beyond that its crank case, which is of aluminium, is formed in one with the dynamo bed-plate so constituting a rigid bed. The ignition is by high-tension magneto, and the lubrication by pump circulation; the cylinder is provided with a water-jacket, the water, which is circulated by a pump, being carried in a small tank above the engine; for cooling purposes an ingenious form of radiator is employed; this consisting of six sections or disks embracing a rotary fan fixed to the flywheel. The petrol tank, which is centrally located above the radiator, has a capacity of one gallon, which is stated to be sufficient for a continuous run of about seven hours.

The dynamo or generator is of the reverse compound-wound type, having an output of 10 amperes at 70 volts, and is directly driven by the engine. The latter is put in operation by means of a pulley on the rear end of the dynamo spindle, the necessary initial impetus being given by a strap working on the pulley. The engine is fitted with a centrifugal governor which acts on the throttle valve in the carburettor; by means of a knurled nut and an adjustable spring the engine speed can be varied between wide limits.

The switchgear, which is entirely enclosed in an aluminium case mounted above the dynamo, is of the rotary type and furnished with outside operating handles; it is arranged to give any of the following combinations:—(1) off position; (2) battery to X-ray coil; (3) battery charging, and dynamo and battery in parallel to X-ray coil; (4) dynamo and X-ray coil only; (5) battery and dynamo in series to X-ray coil. The voltages to the coil are approximately:—No. 2 position, 36 volts; No. 3 position, 36-45 volts; No. 4 position, 75 volts; and No. 5 position, 110 volts.

Simplex Reflectors.

Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have introduced a new reflector, known as the "Anti-Zeppelin," made in enamelled steel, with a special diffusing reflecting surface inside. These are made in two types, "Extensive" and "Intensive," which terms define the light distribution, and are designed for both half-watt and ordinary metal filament lamps. The half-

Fig. 4.—Anti-Zeppelin "Intensive" Reflector.

watt reflector is fitted with a tube, screwed ⅜ in. brass, of suitable length for 100-150-200-watt lamps. Upon removing this tube, the reflector is suitable for a Goliath holder for 300-watt lamps.

For ordinary metal filament lamps, the reflector is made with a 1½ in. hole for attaching to the shade carrier holder; a special watertight holder can be supplied for outdoor use of these reflectors.

These "Anti-Zeppelin" reflectors are described in list No. 614, which also illustrates Simplex lanterns for half-watt lamps up to 1,500-watt size.

The "Overseas" Rectifier.

The Overseas Engineering Co., Ltd., of 75, Curtain Road, E.C., have introduced a patent electrolytic rectifier, principally for charging accumulators, for medical and X-ray work, electro-plating and running small motors. These are standardised for use up to 150 volts, above which pressure an auto-transformer is employed.

The rectifiers are constructed in four sizes for from 2 to 10 amps., the two smaller sizes consisting of a single earthenware cell, with a central anode in solution, while the two larger sizes are four cell rectifiers designed for continuous work and of heavier make.

The A.C. mains are connected direct with terminals on the apparatus, and the charging rate is regulated by means of carbon-

filament lamps mounted on the rectifier itself for the 2 amp. size, and on a separate base for larger sizes; no charging board, resistances or measuring instruments are necessary so that the cost of the installation is low.

Fig. 5.—Small Electrolytic Rectifier.

Fig. 5 shows a small rectifier of this type.

Electrically-Operated Air-Regulating Device for Diesel Engines.

A substantial improvement in the operation of Diesel engines is obtained by regulating the pressure of the air which blows the fuel into the cylinder according to the amount of fuel blown in, the latter varying with the load. Such regulation is usually carried out by hand, demanding considerable attention on the part of the engine driver.

Messrs. Mirrlees, Bickerton & Day, Ltd., of Hazel Grove, Stockport, have, however, now introduced an automatic apparatus to obtain the desired result, which is made for either mechanical or electrical control, a description of the latter type being as follows:—

Referring to fig. 6. In this the current from the dynamo is passed round the coil (*a*) in such a way that this controls the finger (*b*) exactly as the finger of an ammeter is controlled by the current flowing through the ammeter. The finger, however, instead of pointing to ampere readings, is arranged to move round the scale of a pressure gauge, and point to that blast pressure which is best for the engine for the amount of power being generated at the moment. The pressure gauge shown is connected up with the blast pipe, consequently its finger (*c*) points to the blast pressure. Both fingers are provided with contact pieces (*d*) and (*e*) shown in detail in the small figure. The two fingers are insulated from each other, but are connected up with an electricity supply. The amount of current used is very small, therefore the fingers can if necessary be connected to a battery. The supply is also connected

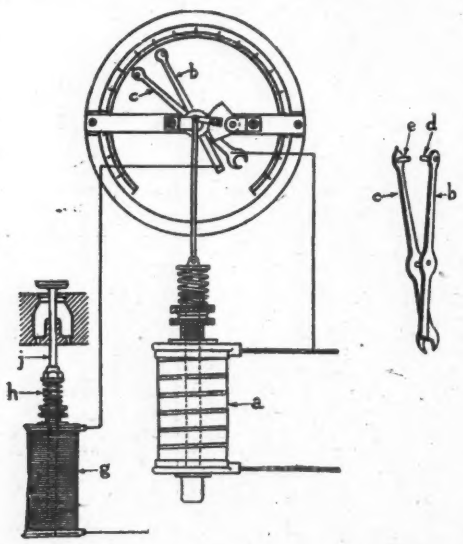


Fig. 6.—Air-Regulating Device for Diesel Engines.

with the solenoid (*g*) in which the plunger (*h*) works. This plunger is connected with the stem of the air compressor throttle valve (*j*). Normally this throttle valve would be wide open and admit a full supply of air to the air compressor, in which case the pressure in the blast receiver would with any load on the engine rise rapidly, as the air compressors are always made with a substantial margin of capacity.

Supposing now that the engine is at work and that the pressure in the air receiver is lower than that indicated by the finger (*b*) as being the proper pressure for the load, the air compressor would pump at its full capacity into the receiver and rapidly increase the pressure, so causing the finger (*c*) to catch up to the finger (*b*) and make contact between the contact points (*d*) and (*e*). As soon as this occurs, current will flow through the solenoid (*g*) and the plunger will be drawn downwards into the solenoid, thus closing the throttle valve, and this valve will be held closed whilst the two fingers remain in contact. As soon as the pressure drops a little and the gauge finger (*c*) falls away from contact with the finger (*b*), then the circuit will be broken and the throttle valve will re-open. In this manner the pressure in the air receiver will be automatically regulated in accordance with the load on the engine.

The apparatus results in smoother running of the engine, less attendance, and in case of alternators run in parallel, both putting them into parallel and running them are facilitated.

Messrs. Mirrlees, Bickerton & Day have also recently introduced a crosshead type of Diesel engine (which was referred to in our issue of January 28th, page 116).

This construction is more costly than the trunk piston construction, but for large engines it has particular advantages in that piston troubles are reduced and trouble with connecting rod top-end bearings is decreased; cylinder wear is also lessened and lubrication improved.

The engine height is increased, but owing to the necessity with the trunk type of allowing headroom for withdrawing both piston and connecting rod clear of the cylinder, while with the crosshead type only the piston needs to be lifted clear, the height of the engine room will not necessarily be increased.

LEGAL.

Batteries from Holland.

Before the Recorder (Sir Forrest Fulton, K.C.) and a jury, in the Lord Mayor's Court, on January 27th, Mr. Isidore Grunhaus, fancy goods importer, of 142 and 145, Houndsditch, E.C., sought to recover the sum of £36 13s. 6d., the price paid for goods which were defective, and loss of profit on their sale, from Mr. A Franco, importer, of 10, Clothier Street, Houndsditch, E C.

Mr. E. Zeitlyn was counsel for the plaintiff, while the defendant was represented by Mr. C. J. Conway.

It was stated that in January of last year the defendant, who then had business in Holland, called on the plaintiff and asked him to store a number of dry batteries used in flash lamps. The defendant said that if the plaintiff could find a customer for the batteries he would sell them at 4½d. each. Some days later the plaintiff received an offer for the goods, and he wrote to the defendant at the Victoria Hotel, Amsterdam, offering to purchase them at 4s. a dozen, less 2½ per cent. discount. The defendant telegraphed back refusing to accept anything under 4s. 3d. per dozen. Finally the plaintiff agreed to purchase the batteries at 4½d. each. He took over 4,800 batteries, received a three months' guarantee with them, and a discount of 3½ per cent. The price paid for the batteries was £81 16s. 3d. The plaintiff sold the batteries to Messrs. Rowarth Bros., of Norwich, who returned no less than 1,964 on the ground that they were defective. The plaintiff immediately informed the defendant that a large number of the batteries were "dead," and asked for others to be sent in their place. After some correspondence, defendant asked for the batteries to be returned to a firm in Amsterdam. The plaintiff, however, refused to send them back as requested, pointing out that he had dealt with the defendant, and did not know any other person in the matter.

In his evidence, the Plaintiff stated that he purchased the batteries at 4½d. each, and sold them at 4½d. each. The Witness said he did not have much confidence in the defendant, as he had only sprung up since the war started. He told the defendant that it was usual to have a three months' guarantee with such goods. That was the custom of the trade, although some manufacturers gave a six months' guarantee

Counsel for the defence said he would not dispute that some of the batteries were defective, r that there was a guarantee given.

In cross-examination, the Plaintiff said that he was told by the defendant that more batteries were being sent over to replace the defective ones, but the ship in which they were consigned was sunk by the Germans. A second ship containing batteries was captured by the enemy. It was untrue that at the outset the defendant told him that the batteries were made by the Fabrik Metrom, of Amsterdam.

The Defendant, who said he was a Dutchman, and formerly traded in Belgium, said that at the outset he told the plaintiff that the goods were made by a manufacturer in Holland, who would guarantee every battery. At a later date, when he actually sold the goods, he told the plaintiff who the manufacturers were.

The Recorder said that in the receipt which the defendant gave he signed his own name to the guarantee, and the name of the manufacturer did not appear.

The Jury returned a verdict for the plaintiff for the amount claimed, and judgment was entered accordingly, with costs.

Bergtheil & Young, Ltd., *v.* Lindley.

In the King's Bench Division, on January 27th, before Mr. Justice Atkin and a special jury, an action was brought by the plaintiffs against Mr. R. H. N. Lindley, of the firm of C. Lindley & Co., Ltd., tool makers, &c., Englefield Road, London, E., to recover damages from the defendant for an alleged slander which he was said to have uttered to a representative of the plaintiff firm at his business premises. The defendant denied that he uttered the words complained of, and he said if they were uttered they were spoken on a privileged occasion and without malice and *bonâ fide*.

Mr. Neilson appeared for the plaintiffs, and Mr. Dale represented the defendant.

Mr. Neilson said that the plaintiffs were electrical engineers in a large way of business. The alleged slander was a very serious one, as it was spoken of the plaintiffs in regard to their trade and business. The plaintiffs were an English company carrying on business here; they had large works at Parson's Green and Stoke Newington, and the slander they complained of was to the effect that they were a German firm. The plaintiffs employed many hands, and had had a deal of Government work, and it was a matter of great importance to them to have it made generally known that they were not a German firm. The plaintiffs had a Mr. Stent in their employ, and he had occasion to go to the defendant's premises about some lathe-chucks, and it was then that the defendant uttered the words complained of. The suggestion made now by defendant was that the words he uttered were in relation to his inquiries concerning the plaintiffs and their goods. The plaintiffs' complaint was that defendant said, with reference to their name:—"They are a German firm, and we will do no business with them whatever. They are a German firm, and it is a German name." It was asserted that the words were spoken on a privileged occasion, but it was not a plea of privilege to which he (Counsel) was accustomed. The jury would appreciate the extent of the harm that might be produced upon the plaintiffs' business by such a statement as this; its effects would be incalculable, and the plaintiffs desired that the true facts should be known. His clients were not out for money, and if Mr. Dale was ready to apologise now on behalf of the defendant, his clients would be satisfied. The plaintiffs employed about 1,000 hands. The company was a limited company registered under the Joint Stock Companies' Act in 1904. There were two directors only. Mr. Arthur Bergtheil and Mr. Edward Bergtheil, and all the people connected with the company, were English. The father of Mr. Arthur and Mr. Edward Bergtheil died in 1901, at the age of 82. He had lived in England since 1866. He came from Bavaria as a boy, and his sons, Edward and Arthur the present directors, were born at Paddington. The father, Mr. Bergtheil, was for some years a member of the Legislative Assembly of Natal, which involved his naturalisation. The plaintiff company was, therefore, an English company, and the slander was a very serious one. The name of the plaintiff company had now been altered to Berkeley & Young, with the consent of the Board of Trade.

At the close of Mr. Neilson's opening statement, Mr. Justice Atkin observed that it seemed to him that the object of the plaintiff's action was achieved, as it merely desired to give publicity to the true facts concerning the plaintiffs. Under these circumstances it seemed to him that something might reasonably be done to settle the matter. He would see counsel on both sides in private consultation if it was so desired.

After a consultation in Mr. Justice Atkin's room, it was announced that the case had been settled, and that the record in the action would be withdrawn.

Mr. Dale, addressing the Court, said that he wished to say on behalf of the defendant, Mr. Lindley, that he personally considered that he was justified in defending the action. There was no ground, the defendant thought, for the action to be brought at all, as he (Mr. Lindley) never uttered the words that were complained of, and he was only inquiring at the time as to the nationality of the plaintiff firm and their goods. If, however, by a certain construction the words that he uttered could be regarded as damaging to the plaintiffs, he was willing to say that he was sorry. He was ready to say that he was satisfied with the explanation given by the plaintiffs as to their nationality, and he did not suggest that they were anything other than a reputable English firm.

Mr. Justice Atkin said the settlement was satisfactory. It seemed to him that observations by Mr. Lindley in regard to the plaintiff company might have been misunderstood.

The record in the case was accordingly withdrawn.

Munitions Court Cases.

At a sitting of the Munitions Tribunal at Dundee on Friday, Frank Atkinson, electrician, asked a clearance certificate to enable him to leave an Arbroath controlled firm and accept service on urgent Government work. He stated that his work could be done by an older man, and he complained that his wages, £2 15s., were not sufficient in view of the amount of overtime he worked. In the event of breakdowns he was expected to work to any hour. He further stated that as the works were electrically driven they required great attention and he could not get time to make repairs. The Chairman said the certificate would be refused, and if Atkinson thought his wages were inadequate he could appeal to the Board of Trade.

At the Blackburn Munitions Tribunal on January 26th a Corporation employé—a cable jointer—asked for release from his work in order that he might join the Forces. He said he either wanted to enlist or to be given more work to do on munitions. A Corporation official said they would do their best to meet the applicant in this, and the man thereupon said he was satisfied.

At Oldham last week an electrical instrument maker employed at Hollinwood, complained that his release certificate had been unreasonably withheld by his employers. His case was that he was employed on the erection of house service meters, and not being on Government work, not having an official badge, and not being, as he alleged, in receipt of trade union rate of wages, he had applied for work which would place him directly on Government business, and would bring him in the trade union rate of pay. His earnings with the firm were 33s. per week and 3s. war bonus, and at his new place he was to get 39s. and 4s. war bonus. A representative of the firm said it was difficult to say exactly whether the man was on war work or not. Before a badge could be given to a man he must be substantially employed on war work, and, in his opinion, the applicant had been on war work during the past six weeks. He had been engaged on meters for munition works, power stations, or on meters for submarines. Mr. W. Sellars (chairman) said that whilst meters for submarines undoubtedly were war work, he was not satisfied that the making of meters for ordinary works and power stations could be considered war work. The firm's representative said the firm had undertaken to let any man not engaged on war work go into the Army. There was a suspicion that there was more behind the application than had come out. The applicant had a friend who had worked for the Hollinwood firm, and as he had not had good health, the firm offered to release him so that he could recuperate. He had since got a job in the south, and the firm there had written to the applicant and other workers at Hollinwood offering them jobs. The speaker added that there was an increase of 2s. due to the applicant, but he said he would rather go to the place where his friend was, as his health was not so good. The Chairman said that was an after consideration entirely. The application was refused.

Southampton Corporation *v.* Duguid.

At the Southampton County Court, the plaintiffs sued defendant for the cost, under a hire-purchase agreement, of electric fittings (£7 14s.) in the house occupied by him. From the evidence, it appeared that the house was previously occupied by a town councillor, and defendant agreed to take over the installation, it being promised that supply should be immediately connected if defendant paid £1 2s. 1d. then due. The next quarterly account for the installation was received, and he then said that he had only agreed to pay one sum of £1 2s. 1d. Defendant said he did not know when signing the agreement that he was making himself responsible for more than one single payment of £1 2s. 1d., and he paid that because he wanted to get into the house. He did not read the agreement, and there was no writing in the body of the agreement at the time. Later he heard from a Corporation canvasser that the amount of the alleged debt had been written off. The Judge, according to the *Hampshire Independent*, held that there was no agreement on the part of the defendant to pay the money.

An Irish Arbitration.

In this arbitration, to which we referred in our last issue, Mr. A. E. Porte has now given his award. According to *Freeman's Journal*. Mr. Brunker's claim was for £373, the balance of the contract and for extra work done.

The Marquess of Sligo made three counter-claims. He claimed a sum of £109 for alterations as to prices and deductions made by Mr. R. E. Mellon, the architect, from the contractor's accounts. A sum of £36 was allowed for this by the arbitrator. He claimed a further sum of £157 paid to Messrs. Edmundson's, Ltd., for completing work alleged to have been left undone by Mr. Brunker. The arbitrator allowed £62 5s. 3d. for this claim. The claim of the Marquess of Sligo for a penalty of £10 per week for delay was wholly disallowed. The Marquess of Sligo is to pay his own costs and the arbitrator's fees and expenses, and to pay five-ninths of Mr. Brunker's costs.

A 1,000-KW., 1,000,000-Volt Transformer.—According to the *Electrical World*, C. H. Thordarson, of Chicago, erected in the Exposition Grounds, San Francisco, a 1,000-KW., 1,000,000-volt transformer for 60-cycle operation. The windings were submerged in a 225-barrel concrete tank of oil, and the transformer complete weighed 30,000 lb. The low-tension 2,200-volt coils, of which there were 122, were connected in pairs across the 2,200-volt supply mains, with their midpoints grounded to the transformer frame. The 1,000,000-volt winding consisted of 190 coils wound with flat aluminium conductors insulated with paper. Some 90 miles of aluminium conductor and 270 miles of paper ribbon were used in the construction of the high-tension winding. Mr. Thordarson estimated the cost of the transformer at $30,000, including special winding machinery.

WAR ITEMS.

The Question of Electrical Concessions in Russia.—According to a report published in the principal German commercial newspaper, no companies in Russia at present are in a more difficult situation than those which are engaged in the supply of energy for lighting and power purposes, including tramways. The annually increasing profits of these companies, which are mostly equipped with foreign capital, are said to have aroused, in the case of the State and the municipal councils, the desire to take advantage of the existing conjuncture of war by expropriating these profitable undertakings at as little cost as possible. We can understand an object of this kind when aimed at ventures in which German interests are chiefly concerned, but as a large amount of Belgian and French capital is also invested in these classes of undertakings in Russia, we assume that the Teutonic statement of the case, although it does not specifically mention any nations other than Russia and Switzerland, applies solely to companies in which German capital has exercised control in the past. At any rate, a dispute is reported to have arisen between the Government and the local authorities as to the future ownership of the supply works and tramways. At present two official projects are in opposition to each other. The first has been prepared by the Minister for Home Affairs, who proposes the compulsory transfer to the cities and towns of electrical undertakings which are of public interest. On the other hand, the Minister of Commerce is credited with a scheme for conferring upon the State a monopoly for granting concessions for these undertakings, and stipulating also that the owners of existing concessions must apply to the State for a concession to continue their business. The latter project is declared to have evoked great opposition in technical circles, and the Society of Engineers and Electro-technics, of Petrograd, has raised a protest against it. The scheme, which would deprive certain towns of large receipts, also contemplates the imposition of conditions which are much more unfavourable than those hitherto fixed in the case of concessions, and which would tend to check applications for such privileges. On one point only are the State and the local authorities said to be in agreement, namely, that the compensation to be paid to present holders of concessions shall be as little as possible; and both schemes proceed from the idea that a kind of expropriation has become necessary in the public interests. It is contended that the working of concessions is only right according to form, but that in fact it is the usurpation of a right devolving upon the general community, and the immediate and forcible rupture of the concessions would only represent the establishment of normal legal conditions. On this basis the companies would only be compensated for the fixed and movable assets in the shape of stations, cables, etc., but would receive nothing for the loss due to the stoppage of the concessions. It is stated that this principle has already found expression in practice in the case of the Kieff Tramway Co., whose works and rolling stock have been municipalised against the company's wish; and whilst the company claimed £2,100,000 by way of compensation, the City Council, excluding any indemnity for the concession, is only willing to pay £750,000. The report also refers to the well-known case of the Moscow Supply Co.—the branch of the Petrograd Electric Lighting Co. of 1886—although in this instance the Moscow City Council some time ago offered to pay a moderate compensation for the unexpired term of the concession. More recently, however, the Town Council has sought to secure a reduction in the charges for supply from the State sequestrator, and the German suggestion from this fact is that the nearer the business of a supply undertaking is brought to the state of ruin the better will be the prospects of the Russians acquiring it at a "slaughter price."

Trade After the War.—Opinion is becoming more divided as to whether, at the conclusion of the war, Germany will be ready immediately to enter upon a trade war. Mr. T. Russell, speaking at the Rotary Club, Edinburgh, on the probable condition of trade after the war, said (according to the "Financial Times"):—"At the close of the war, Germany would not be ready to compete. Germany was short of materials. Before she could dump goods she must obtain the material to make them with—and means to pay for them. Many of her factories were closed already. Competition after the war would come from America long before it came from Germany."

Enemy Shareholdings in Australia.—Reuter's representative at Melbourne reports that the Federal Executive has approved regulations for the wiping out of enemy and naturalised shareholders in public companies and making the transfer of their shares to the Public Trustee until a year after the war obligatory. Before April 15th enemy shareholders may apply to the Attorney-General, after transfer, to have their shares sold, and they will receive the proceeds. The regulations provide for the payment of dividends on enemy shares to the Public Trustee after allowing reasonable living expenses.

Swedish Export Prohibitions.—An order has just been issued by the Swedish Government prohibiting the exportation from the country of insulating composition containing asbestos and manufactures of such composition.

Enemy Firms in India.—In the House of Lords last week, according to the "Daily Telegraph," Lord Sydenham asked the Under-Secretary of State for India whether effective steps had been taken to put a stop to enemy trading in India, and gave an instance of such alleged trading at Bombay. Lord Islington, in reply, said the orders dealing with this matter laid down broadly that all hostile firms in India should cease to trade except under licence by the Government of India. The House might rest assured that the Government of India would actively co-operate with the Home Government in carrying out the intention of preventing these enemy firms from remaining permanently amongst us.

Prohibited Exports.—The exportation of pocket-lamp cases and cases fitted with bulbs, but not containing batteries, to all foreign countries in Europe, and on the Mediterranean and Black Seas, other than France, Russia (except through Baltic ports), Italy, Spain, and Portugal, is prohibited.

BUSINESS NOTES.

Book Notices.—*Aeroplanes and Airships.*—By W. E. Dommett. London: Whittaker & Co. Price 1s. net.—Like the book on "Submarine Vessels," by the same author, this is a popular and elementary book for the edification of the general reader, but being the work of an author who knows his subject, is not so "popular" as to be without interest to an engineer. It deals with the principal features of aircraft of all kinds in an entertaining and instructive manner, and is quite suitable for those who, not having time to study the subject fully, yet desire to have sound general ideas upon it, and to be in a position to understand the nature and bearing of new developments. The only feature of the work to which we take serious exception is the author's literary style, which in many places is really shocking. What, for instance, is an "increasing fitment," and how is it "practised"? We learn that "smokeless powder is used which makes it very difficult for the location of an artillery battery," and the aerial bombardment of German submarines in Ghent Harbour is mentioned as an operation frequently performed. There is a canal there, but does the author really mean Ghent? If the author would have his proofs read by a competent friend, the pleasure of reading his book would be very greatly enhanced.

Excess Profits Duty and Excess Mineral Rights Duty. By R. M. Montgomery and W. Allen. London: Butterworth & Co. Price 7s. 6d. net.—In this book the authors give an explanation of the Finance (No. 2) Act, 1915, which imposed the new War Tax known as the "Excess Profits Duty." The chief provisions of the Act are explained in due order, and instructions are given as to finding whether the profits of any business are liable to the duty, and the amount of the latter. The Act is also analysed and discussed in detail, and, finally, the complete Act is printed without notes, for convenience of reference. The book should be found very useful by those in charge of the accounts of firms which come within its scope.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXV, No. 1. January, 1916. New York: The Institute. Price $1.

"Technical Paper of the Bureau of Mines." No. 123. "Notes on the Use of Low-Grade Fuel in Europe." Washington: Government Printing Office.

"A Meteorological Treatise on Circulation and Radiation in the Atmospheres of the Earth and the Sun." By F. A. Bigelow. London: Chapman & Hall. Price 21s. net.

"*Journal* of the Institution of Electrical Engineers." Vol. LIV. No. 255. February 1st, 1916. London: E. & F. N. Spon, Ltd. Price 3s. 6d.—This issue contains the following papers:—"Predetermination of the Performance of Dynamo-Electric Machinery," by Prof. Miles Walker; "Proposed Standard Numerals for the Scales of Measuring Instruments," by Mr. A. P. Trotter; "Hydro-electric Power in New Zealand," by W. Wilson.

"Experimental Wireless Stations." By P. E. Edelman. Minneapolis, Minn, U.S.A.: P. E. Edelmann. Price $1.50.

The Import Trade of India.—The Board of Trade *Journal* publishes the following figures taken from a report of the Director of Statistics to the Indian Government:—

12 months ended July 31st,	1913. Rupees.	1914. Rupees.	1915. Rupees.
Railway plant and rolling stock	76,214,500	112,766,200	76,445,400
Metals—Iron and steel, and manufactures thereof ...	138,263,000	156,234,500	77,992,900
Machinery of all kinds, including belting for machinery	69,810,900	82,839,200	54,833,200
Cutlery, hardware, implements (except machine tools), and instruments ...	59,594,700	62,957,500	35,054,500
Metals, other than iron and steel, and manufactures thereof	45,627,000	65,181,500	25,630,500

Rupee at par = 1s. 4d.

Catalogues and Lists.—General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—Leaflet announcing altered prices of ignition dry batteries (Hellesen) consequent upon the new import duty on "motor accessories," and the decision of the Customs authorities that these batteries come under that heading. New pamphlet (R 1,951) of eight pages, giving illustrations and prices of Robertson carbon-filament lamps for various classes of illumination, flame or candle lamps, tubular lamps, heating lamps and battery lamps. A number of views are given of the Osram-Robertson lamp works and the glass works at Lemington-on-Tyne.

Messrs. Simplex Conduits, Ltd, Garrison Lane, Birmingham.—Illustrated circular (No. 416) giving particulars and prices of Anti-Zeppelin reflectors for half-watt and metal-filament lamps, also Simplex lanterns for half-watt lighting in shops, factories, &c.

Messrs. Mirrlees, Bickerton & Day, Ltd., Hazel Grove, near Stockport.—12-page pamphlet containing a full and illustrated description of Mirrlees-Diesel engines of their new "Crosshead" type. Also a list describing their electrically-operated air regulating device for Diesel engine compressors.

British Thomson-Houston Co, Ltd., Rugby.—12-page illustrated price list (No. 5,100 A) describing their starting resistances for C.C. motors.

Messrs. A. D. Riley & Co., Ltd., of Wellington, N.Z., have sent us a pamphlet containing a reprint of a description of the municipal sewerage system of Petone, N.Z., for which they were the contractors, with Mr. Wilson Ormrod, A.M.I.E.E, as their engineer.

The Edison & Swan United Electric Light Co., Ltd., of Ponder's End, have prepared for advertising purposes what they term "Current Economy Correspondence Cards." The firm's trade customers will be able to obtain quantities printed with their own name and address so that the reply half with the order reaches them.

The Growth of Mazda.—Production has been so greatly increased in the lamp works at Rugby that new plant has trespassed on the normal storage space, leaving insufficient room to accommodate the stock. The B.T.H. Co. has, therefore, taken over the Rugby skating rink to provide more storage capacity. The annexe itself is already crowded, and a second floor has to be built immediately to facilitate working in the building and add to its capacity. At the same time the existing medley of lighting devices will be replaced by high-efficiency units on the well-known B.T.H. principle. The Mazda lamps are taken by an electric automobile to the new store, which is situated very near the railway station, thus ensuring rapid dispatch.

Board of Trade Exhibition.—The Board of Trade Exhibition in London opens on February 21st, and will continue until March 3rd. At Stand No. A 16, Messrs. Ward & Goldstone, notwithstanding that they are full up with work and are under Government control, will be, by special permission, exhibiting a large variety of their manufactures, principally of goods which, previous to the war, were made almost entirely in Germany. The exhibit will include a large range of electric pocket lamps, torches, refills for same, hand lamps, electro-medical apparatus, &c., also electric appliances for the car and garage.

Liquidations.—Automatic Electric Block Signalling Co, Ltd.—A meeting of creditors is called for February 9th, at 10, Victoria Street, S.W., to hear an account of the winding up from the liquidator, Mr. A. Colls.

Sheffield Electrical Engineering Co., Ltd.—A meeting is called for February 29th, at Ashton-under-Lyne, to hear an account of the winding up from the liquidator, Mr. H. Cawood.

Trade Announcements.—The business of Venners Signs, Ltd., is being continued at 6, Old Queen Street, Westminster, S.W., under Mr. Batteson.

The Ebury Electrical Engineering Co., of 80, Ebury Mews, Victoria, London, S.W., have been appointed British agents for the Dyneto electric lighting and engine starting sets for motor cars.

Mr. E. J. Jarvis, electrician, of 48, Mutley Plain, Plymouth, announces that he is retiring from business.

The Palmer Electrical Co., who represent the Nya Foerenade Elektriska, of Sweden, state that they hold a stock of electrical supplies, motors, &c., at their new address at 52, High Street, London, W.C.

Prices Advance.—The Jackson Electric Stove Co., Ltd., announce a further increase of 10 per cent. in all their prices consequent upon the continued increase in prices of raw material and labour.

Bankruptcy Proceedings.—G. E. Bonner, electrical engineer, Palmer's Green, Middlesex.—First meeting, February 11th, at 14, Bedford Row, W.C.; public examination, February 21st, at the Court House, Edmonton.

For Sale.—The Corporation of Nuneaton has for disposal one 170-kw. Willans-Siemens direct-coupled D.C. generator, 350 amperes, 460 to 500 volts. The Tramways and Electric Lighting Committee of Swansea has for disposal the following electrical plant:—One 100-H.P. Willans & Robinson engine direct coupled to a 75-kw. Siemens-Schuckert 440/460-volt shunt-wound D.C. generator, and one 300-H.P. McLaren marine type engine, direct coupled to a 225-kw. Siemens-Schuckert 440/550-volt D.C. compound-wound generator, complete with a Yates & Thoms jet condensing plant. See our advertisement pages to-day.

An Inquiry from Canada.—H.M. Trade Commissioner in Canada reports that a manufacturers' agent in Montreal wishes to get into touch with United Kingdom manufacturers of electrical goods, and he desires to receive catalogues, price lists, &c. (Reference No. 16.) Apply to the Board of Trade Commercial Intelligence Branch, London.

LIGHTING AND POWER NOTES.

Accrington.—Proposed Extensions.—It is anticipated that owing to the rapidly increasing demand, extensions to the electricity works, involving an outlay of £25,000, will need to be undertaken by the Electricity Committee in the near future. A special meeting of the Committee is being called to consider the matter.

Australia.—Melbourne Wiring Schemes.—Although the City Council rejected the proposal to install electricity in city buildings under which the Council would be reimbursed in 30 monthly payments by the owners, the Electricity Committee has had under consideration and has recommended another scheme based on the hire-purchase system. The Committee is of opinion that unless some scheme is devised for assisting owners to wire the comparatively old premises in the city, the supply of current to these will always be very limited notwithstanding the low rates of charge for electricity for lighting, which are the lowest in Australia. After investigation and examination of similar schemes in other parts of the world, the Committee considers that it is desirable for the Council to introduce a hire-purchase scheme for the wiring of houses in the city, viz., at the signing of the agreement 10 per cent. of the estimated or ascertained cost of the installation to be paid, and the balance of cost in equal quarterly instalments plus interest at the rate of 6 per cent. on the amount outstanding. On the assumption that each year 500 installations of the average size are wired, the annual outlay on the part of the Council would be about £3,500. The Committee also considered a scheme providing for the hiring out of electric motors, electric irons, heating, cooking, and other electricity consuming devices. The Sydney City Council electric supply department have to-day on hire to consumers 2,546 electric motors, aggregating 12,160 H.P., at a capital cost of £60,000; the Committee considers that increased revenue from the sale of current in this direction, under Melbourne conditions, would produce about £50,000 per annum. So far as electric cooking is concerned, the Committee is disposed to wait until a supply of reliable and reasonably priced cooking apparatus is available on the market before extending the scheme in this direction, realising that in order to foster a demand for electricity for cooking, it would be necessary to arrange for the hiring out of cookers to the consumers. As the Council's statuary powers are restricted to the supply of electricity, it will be necessary to apply to Parliament for additional powers to cover the propositions recommended in the report.—*Australian Mining Standard.*

In connection with the West Australian power plant now being erected at Perth, the Federal Council of the Electrical Association of Australia has made representations to the Premier of West Australia on the desirability of maintaining a 50-cycle frequency throughout Australia, but it is said that the 40-cycle scheme is too far advanced to revert to the generally accepted Australian standard.—*Commonwealth Engineer.*

The Long Reach Electric Lighting Co. (Queensland) has been formed to utilise the pressure from the local artesian bore to generate electricity for lighting the town, and has applied to the Council for its consent to an Order in Council being granted for this purpose.

The Hamilton (Queensland) Council has decided to instruct an electrical engineer to prepare plans for lighting the town with electricity.

The Kilroy Shire Council (Queensland) is also applying to the Government for a loan for the purpose of an electric light installation.—*Tenders.*

Birkenhead.—Revised Prices.—The T.C. has revised charged for current as under:—In the borough, ordinary lighting, 4d. per unit, plus 10 per cent.; ordinary power and heating, first 1,500 units per quarter, 1½d. per unit, plus 10 per cent.; beyond, 1d., plus 10 per cent. Prepayment meters, increase from 4½d. to 5d. Outside the borough, ordinary lighting, 5d., plus 10 per cent.; ordinary power and heating, 2d., plus 10 per cent.; prepayment meters, increase from 5½d. to 6d.

Bolton.—The L. & Y. Railway has agreed to bear the cost of new mains in Rake Lane to serve the company's new electric power station at Clifton Junction.

Chelmsford.—Public Lighting.—The T.C. has so far failed to come to a definite arrangement with the Electric Supply Corporation, Ltd., as to payments for public lighting on account of the restricted use of lamps. The company offered a rebate of £700 per annum, but the Council wishes to pay only £330 per annum, or a *pro rata* amount for any shorter term whilst the lamps remain extinguished. The company declined to agree to this proposal, but intimated that if an arrangement was made as to a new contract when the present one expires next March, it would probably be prepared to agree to the Council's proposals regarding payment under the existing contract. The question has been referred to a Sub-Committee, which is to confer with the company regarding the suggested new contract.

Canada.—The electors of the city of Edmonton have approved the agreement between the city and the Edmonton Power Co. for a supply of electricity to the city for a period of 30 years on a KW.-hour basis, the price varying from 1·3 cents down to ·85 cent per KW.-hour, depending on the quantity taken.

The Edmonton Power Co. controls the water rights of the Saskatchewan River at Rocky Rapids, but on account of bad regulation in this district, dams will have to be built further up the river, and one of these will be placed some 10 miles back from the power house. The scheme of development at this point, including adequate water storage, has been under consideration for about three years, and some 60 square miles of land have been surveyed, and will be cleared and prepared for an artificial lake to impound the necessary water. The scheme is estimated to cost $6,000,000, this including an electric railway from Edmonton to the power site; the work will take probably four or five years, but the company has offered to at once take over and operate the present steam plant and sell electricity at 1·3 cents per KW.-hour to the city, which is to be responsible for the capital charges. It is estimated that the present generating cost of power in Edmonton is approximately 2·75 cents per KW.-hour, exclusive of distribution charges.—*Canadian Electrical News.*

China.—A Shanghai Report.—Mr. A. H. Preece, of Messrs. Preece, Cardew, Snell & Rider, consulting engineers, has recently reported to the Shanghai Municipal Council on the progress of the electrical undertaking and future plant extensions required to keep pace with it. So rapid has been the increase in output, that Mr. Preece forecasts annual additions of 10 or 20 million units, the annual demands increasing every year by 4,000 or 5,000 KW. As regards lighting units only, Shanghai increased from 5·4 millions in 1912 to 14·7 in 1915; that is, it is well ahead of Birmingham, and equal to Manchester in 1911.

In the matter of power units, over 30 millions have been added in three years. The expansion of the undertaking is regarded as inevitable, and it is only necessary to decide on the most suitable plant. New power consumers will reach 4,850 KW. in 1916, and there is evidence that in 1917 a further 3,000 or 4,000 KW. will be required, this being distinct from domestic lighting, heating and power, which has averaged an addition of 2,000 KW. for five years. Summarising the position, future maximum loads are anticipated of 19,000 KW. in 1916, 23,000 KW. in 1917, 26,500 KW. in 1918, 30,000 KW. in 1919, and 33,000 KW. in 1920.

The present capacity of the Riverside and Fearon Road stations is 18,400 KW., which, allowing one 5,000-KW. set as spare, leaves the maximum safe output at 13,400 KW. Mr Preece concludes from the conditions that the maximum load must be supplied from the Riverside station in future, and that this justifies the provision of at least 20,000 KW. of new plant there, making a total capacity of 34,000 KW. of plant installed; to obtain the 20,000 KW. of new plant he advises the immediate installation of a 5,000-KW. turbine set, also that orders be placed for (*a*) one 10,000 KW. and one 5,000-KW. sets, or (*b*) two 10,000-KW. sets, or (*c*) one 10,000 KW. and one 7,500-KW. sets; a 10,000-KW. set is regarded as essential, and should be ordered at once.

Mr. Aldridge's estimate of March, 1915, for extensions amounted to Tls. 2,276,772, but including the cost of the 5,000-KW. set, the total will amount to Tls. 2,650,000, which will be spread over 1916, 1917 and 1918. By the latter year there will be some Tls. 10,000,000 invested in the undertaking, and Mr. Preece considers that there is little doubt that by then the output sold will have reached 100,000,000 units. He further estimates that as the average selling price will be about c.2·7, and the present price is c.3·28, there is every prospect of reduced prices to lighing consumers.

The report as reproduced in *Eastern Engineering*, concludes with a suggestion as to distributing a portion of the profits of the undertaking for the general benefit of all ratepayers. Owing to the community controlling the undertaking, fresh capital can be raised at 5½ per cent. or so, as against say 7½ per cent. if the undertaking were a private concern; in consequence, it is suggested that the community is entitled to charge interest at say 1 per cent. on the money found by it. The effect of this would have been to raise the interest charge in 1914 to Tls. 34,190 instead of a dole of Tls. 30,255, and in 1915 a similar amount instead of about Tls. 35,000, and he recommends its adoption.

It is reported that a British firm has arranged to install an electrical plant at Handaohedzu, on the Chinese Eastern Railway, 170 miles east of Harbin. The plant will provide for several thousand consumers and street lighting.

Continental.—Italy.—Cabanzaro, with a good part of the province of Calabria II., are about to be supplied with electricity from a large hydroelectric plant, the plans of which have just been completed. The scheme contemplates the enlarging of the small existing plant at Mongiana and Sera S. Bruno to supply the whole of the province, the use of the waters of the Rivers Allaro and Vezzallaro, and the erection of four high-pressure lines. Signor Gino Canzio is responsible for the scheme.

The projected amalgamation of the Società Anonima Elettrica Veronese and the Società Canale Milani has been postponed owing to the opposition of the minority of the shareholders. The scheme is to be submitted to a competent court.

Dover.—New Loans, &c.—The T.C. has decided to apply for a loan of £4,000 for cables necessary to carry out a special contract, for the same purpose the loaning authority has agreed to renew a loan of £157,519 for five or seven years, with option to repay at the end of five years at six months' notice. The Council has accepted tenders for large and small cable.

Exeter.—Workhouse Lighting.—The B. of G. has adopted a report of the surveyor for dealing with the electric lighting of the workhouse, and has decided to advertise for tenders for Block 3 in the scheme.

Haslingden.—Bulk Supply.—Provisional arrangements have been made, with the consent of the Accrington Corporation, for obtaining an additional supply of electricity from Rawtenstall, to supplement that obtained from Accrington. Haslingden is under an agreement to take all the current it requires from Accrington, but as the latter is unable to give a regular supply at present, the two towns have mutually agreed on this course.

Herne Bay.—E.L. Scheme.—The Gas and Electricity Co. has asked the U.D.C. to consent to a further extension of time for carrying out the E.L. scheme for the town, and the clerk to the Council has been deputed to discuss the matter with the directors, and report.

Hornsey.—Price Increase.—The B.C. has increased the price of electricity, from March 31st, by 10 per cent.

India.—The Council of Regency, Bahawalpur State, has decided to give the City of Bahawalpur a public supply of electricity for street lighting and private use. Acting on the advice of the electrical engineer to the Punjab Government, the contract for the generating plant has been placed with Messrs. Balmer, Lawrie & Co., of Calcutta.

Kingsbury.—At last week's meeting of the U.D.C., the Clerk said the North Metropolitan Electric Power Supply Co. had made the Council a small allowance in respect of unlighted lamps, but this had been considered insufficient. A similar point had also been raised by another municipal body, its contention being that it ought not to pay for what it had not received. The case was taken to the High Courts, but judgment had been reserved. Having regard to the fact that the decision would no doubt have a considerable bearing on the position of affairs at Kingsbury, the Clerk thought it would be far better to allow any further report upon the question to be held over. The Council agreed to this course.

Liverpool.—Year's Working.—The total income of the City Council's electricity undertaking for the year ended December 31st last, amounted to £345,808, of which £216,733 was in respect of the sale of energy for lighting and power, £118,824 for tramway supply, and £1,592 for public street lighting. Meter rentals brought in another £4,622, while £2,169 is credited in respect of sales and repairs in connection with installations. Expenditure during the 12 months totalled £136 249. Of this sum £60,868 is entered as generation expenses; £10,525 for distribution; £38,439 for rents, rates and taxes, and £16,497 for management expenses. The balance (£209,558) has been carried to net revenue account, where £50 is added as interest. Against the total is debited £65,749 in respect of interest; £57,635 transferred to sinking fund; and £36,243 transferred to renewal fund leaving £50,000 to be given in aid of the general rate.

The electric supply estimates for the present year provide for an expenditure of £57,191 on the reserve and renewal account, as compared with an actual expenditure of £34,133 in 1915, and £81,516 in 1914. On revenue account an expenditure of £214,837 is provided for, against £171,165 and £145,648 in 1915 and 1914 respectively. It is estimated that expenditure on capital account will amount to £17,167, but in regard to £15,000 of this money the sanction of the Treasury has to be obtained. Last year the expenditure was £2,344, and in 1914, £26,974.

London.—Southwark.—The Electric Light Committee reports that it has found it necessary to again revise the scale of charges for lighting and power. It is anticipated that the alteration in the scale, together with the various revisions, will show an increased income of £5,796.

Manchester.—Plant Extensions.—The L.G.B. has sanctioned the proposal to divert £83,000 of the sum authorised in respect of the Barton scheme for the purchase of machinery to be installed temporarily at the Stuart Street station, in order to relieve the congestion and heavy loads. When the Barton scheme is completed it is probable that this plant will be transferred to the new station.

The coal question is no longer a source of anxiety to the electricity department. Coal is being obtained from Northumberland, the extra price paid being balanced by the higher electricity rates and the augmented consumption of energy.

During December last there was an increase in consumption of nearly five million units of electricity as compared with December, 1914; the increase of the power load was 24 per cent.

New Zealand.—The Ohakune B.C. is considering the installation of an auxiliary generating set as a stand-by to its hydro-electric plant, which was described in our pages of December 17th, 1915.—*Tenders.*

The Riccarton B.C. has decided to borrow £3,300 for electrical reticulation and £200 for wiring private installations.

New Zealand.—BRITISH *v.* AMERICAN TENDERS.—Tenders for the supply of transformers for the electricity department of the Auckland City Council were recently received by the Public Services Committee, and passed on to the electrical engineer, who was informed that the Committee was prepared to consider only British-made goods. The engineer favoured an American tender as it was strictly in accordance with the specification, was complete, and offered material of a high class and a reasonable time of delivery. He said he could only recommend acceptance of English goods if the firms gave a satisfactory promise of delivery at their own works in 12 weeks. If this were done he was prepared to recommend the acceptance of tenders from English firms.

The Committee left the matter in the hands of the Mayor to act after communication by cable with the English firms mentioned.

Ripponden.—The Ripponden Commercial Co., Ltd., is on the point of installing electrical driving, by which it is hoped to save the cost of from 50 to 60 tons coal weekly. One room is to be taken at a time, and each room will have its own motor.

Salford.—PROPOSED LOAN. — The Electricity Committee has recommended that application be made to the L.G.B. for sanction to borrow £13,660 for extensions of plant at Frederick Road station.

The Committee has entered into a new agreement with the Lancashire Electric Power Co., for the supply of electricity in bulk for a period of two years.

The proposed increase of the charges for electricity is to be considered by the Council at its next meeting.

Shipley.—PRICE INCREASE, &C.—The U.D.C. has increased the charges for electricity for power purposes by 10 per cent., from April 1st. This does not apply to cases covered by special agreement.

The Electricity Committee has deferred consideration of an inquiry from Messrs. C. F. Taylor & Co. as to a supply of electricity to Lower Holme Mills, Baildon, until it has been ascertained whether the Baildon U.D.C. would consent to the Council supplying electricity in the Baildon area.

PLANT INAUGURATION.—On Wednesday last a new three-phase turbine set, together with switchgear, boiler plant, &c., at the Council's generating station, was to be officially started up, the proceedings being followed by a dinner at the Institute, Saltaire.

Stoke-on-Trent.—NEW PLANT.—The T.C. has decided to install transforming equipment for a sub-station at the California Works of Messrs. Kerr, Stuart & Co., Ltd., and sanction to the borrowing of £1,200 has been applied for for that purpose, and has been provisionally procured.

Sunderland.—E.L. ESTIMATES.—The estimates of the Corporation electricity department show that the income for the year ending March 31st next, is estimated at £72,102, compared with last year's estimate of £72,361, and £73,517 the sum actually received. The sale of electricity is expected to realise £67,048, compared with last year's actual income of £65,526. A decrease is allowed for in private heating and lighting, the estimate being £16,092, while last year's actual figure was £17,764. Power is expected to give an increased receipt, the figure being £36,858, against £33,640 last year. The total working expenses are expected to be £37,818, against £34,271 estimated for last year, and £34,382 actually spent. There is a considerable increase allowed for in the cost of coal, owing to the war, the estimate being £16,148, compared with £12,479, the actual cost last year. The total expenses are put at £41,306, against £40,090 the actual expenditure last year. There will, it is expected, be carried to net revenue and appropriation account £30,796, against £33,426. the actual amount realised last year. This balance will be apportioned as follows:—Repayment of loans, £17,612; interest on loans, £10,099; interest on lands and redemption, £157; contributions to capital, £963; income-tax on profits, £968; leaving for the renewals fund £995, as compared with £4,653, the amount placed to the renewals fund 12 months ago.

Whitby.—The U.D.C. has concluded arrangements for extending the electricity mains in High Stakesby, contracts for current for a period of years having been entered into with the proprietors of St. Hilda's School, the Manor House and Sneaton Castle.

Wigan.—PROPOSED EXTENSIONS.—The General Purposes Committee has adopted a resolution recommending the T.C. to engage the services of an expert electrical engineer to report upon the Corporation electricity works and upon a proposed scheme involving an expenditure of about £30,000 on new plant. This scheme, which has been under the consideration of the E.L. Committee for several weeks past, is for the provision of an additional 3,000-KW. turbo-alternator, a surface condenser, two rotary converters, one additional water-tube boiler and certain accessories, and the estimated total cost is £30,450.

Whitstable.—The U.D.C., which has undertaken the the generation of electricity for public use for the Electricity Co. at the sewage pumping station, has informed the debentureholders that the work will be discontinued unless certain payments due are paid by a certain date. Regarding the public lighting contract with the company, the latter has offered to accept 35s. per lamp for the period of the war, and counsel, whose opinion on the contract has already been sought, is to be consulted as to the offer.

TRAMWAY and RAILWAY NOTES.

Continental.—ITALY.—The Società Tranvie e Imprese Elettriche is seeking a concession from the Provincial Deputation and the Ministry of Public Works for two lines of electric tramways running respectively from Castellanza, through Olgiate and Cassano to Gallarate and from Gallarate through Lenate and Pozzolo to Oleggio. The necessary surveys for these lines have already been made.

The Central Umbrian Railway, now being provisionally worked with steam traction, will be equipped with electric driving power next year. The current will be supplied to Papigno by the Società del Carburo di Calci. From Papigno three-phase current will be supplied to Marsciano transforming station for conversion to single-phase current. The electric traction will be effected by locomotives, driven by four single-phase motors geared to the axles, each motor of 90 H.P.

The new goods locomotives of the Società Elettrica Bresciana have been built in the works of Messrs. Carminati e Toselli, of Milan, and equipped by the firm of Galileo Ferraris. They are equipped with four coupled motors of 80 H.P. each.

An influential meeting of syndics and other representatives of cities and towns around the Lake of Garda met recently to consider a scheme of extension of the Mantua-Peschiera electric railway. After a long discussion, it was decided to memorialise the Government for the concessions for extensions from Verona and from Peschiera to Lazise and Riva, *via* Mori and Rovereto. The promoters of the scheme have in view the great concourse of tourists that will be attracted to the shores of this beautiful North Italian lake, where the success of Italian arms will have freed the remainder of the Trentino from Austrian overlordship, as well as the knitting of ties with the reconquered territory.

Dudley.—TRAMWAY ACCIDENT.—A second death has occurred as a result of the tramway accident on January 16th, and the inquest formally opened by the Wolverhampton coroner, has been adjourned until February 14th.

Failsworth (Lancs.).—INQUEST.—On Tuesday an inquest was held on Martha Wilkinson, who received fatal injuries in the tramway smash at Radcliffe recently. Harry Pusey, driver of the runaway Bury car, said that when he got half way down the hill on Radcliffe New Road, the car was travelling at about 12 miles per hour, or two miles under the limit allowed; he tried to pull up at the stopping place, but the car commenced to skid, and he attributed the accident to the skidding of the wheels, and to the rails being in a treacherous condition. The car had been all right previously. A passenger thought that just before the collision with a van the car would be travelling at 30 miles per hour. A verdict of "Accidental death" was returned, and the driver was exonerated from blame.

Ilford.—YEAR'S WORKING.—The somewhat belated though instructive report of Mr. L. E. Harvey, the tramway manager, on the working of the Council's tramway undertaking for the year ended March 31st last, shows that there was a deficit of only £21, as compared with a loss of £3,567 on the previous year's operation. The total receipts, £31,981, were £6,188 more than in the previous year, due to the running on the lines leased from Barking and to a reduction in 'bus competition. The car mileage 877,813, shows an increase of 45,918, and the passengers carried numbered 9,203,077, as against 8,036,552 in 1914. We note that the Edison electric tower wagon has been continuously in work, with the most satisfactory results; it has saved time in getting to breakdowns and has been largely used for conveying stores, &c. Mr. Harvey adds his conviction that it would pay the department to invest in a 2-ton electric wagon for permanent way use in place of hiring horses as at present for hauling and cartage work. It is believed that the present year will show a profit on the working of the undertaking, for the receipts are considerably in advance of the previous year's takings.

Lancashire.—A correspondent, writing on the shortage of tramway conductors in South Lancashire, says that this is due mostly to them obtaining far better-paid work in the local collieries, and not, as is usually supposed, to extensive enlistment in the Army.

Liverpool.—YEAR'S WORKING.—The accounts of the Tramway Department of the City Council for the 12 months ended December 31st last, provide for a contribution of £100,000 in aid of the rates. Income from all sources dering the period under review totalled £707,097, traffic revenue contributing £696 893. Expenditure during the period amounted to £483,405, of which £192,353 was in respect of traffic expenses; £86,350 for general expenses, £80,594 for general repairs and maintenance, and £124,106 for power expenses. This leaves a balance of £223,692, carried to net revenue account, where it is increased to £242 673 by the addition of interest and a sum transferred from the suspense account. From this total has to be taken £50,084 in respect of interest, £4,868 for rent of leased lines, £64,526 for sinking fund charges, and £23,193 to be carried to the reserve, renewal and depreciation account, leaving £100,000 for rate aid.

London.—The Metropolitan Electric Tramways Co. is applying for powers to postpone, until three years after the termination of the war, the liability of the Middlesex C.C. to proceed with any tramway and street widenings authorised by Parliament in 1911; also to postpone until the same period the time granted in 1913 for erecting railless traction vehicle equipment in Woodford and Tottenham, from Green Lanes to Ferry Lane.

Manchester.—The trolley boys employed in the tramway department have been dissatisfied for some days past with their pay, and, following the short-lived strike reported in our last issue, brought about because they thought they were receiving less than the new trolley girls who have just been engaged, the boys have asked for an advance of wages of 2s. per week. The Tramways Committee has offered a war bonus of 1s. per week and overtime at the rate of time and a quarter, and at a meeting of the boys last week this offer was accepted. There was a fair minority against accepting the bonus, and these left the meeting and got some of the lads on the cars to cease work again. There was no interference with the car service, and the "strike" quickly fizzled out.

Plymouth.—Tramway Purchase.—The arbitration with regard to the taking over by the T.C. of the undertaking of the Devonport and District Tramways Co. has resulted in the price being fixed at £103,970. The company claimed £257,000, and the Corporation's assessment of the value was £93,000. A loan of £5,000 for the purchase of six new cars has been sanctioned for 15 years.

Rochdale.—In consequence of a shortage of steam at the electricity works, there was a failure of the electricity supply on January 26th, and the cars on all sections were stopped for about 20 minutes.

Sunderland.—Revenue Estimates.—The estimates for the year ending March 31st next of the Corporation tramway department show that the estimated total income is £77,687, of which £77,300 is put down as traffic revenue, compared with last year's estimate of £74,882, and an actual income of £75,615. The working expenses are estimated at £43,467, as against an estimate for 1914-15 of £42 246, and an actual expenditure of £41,549. The traffic expenses are estimated at £20,860, an increase of over £1,000 on last year's figure, largely owing to increases in wages; whilst the general expenses are put at £6,127, compared with £5,608 last year. The sum of £34,222 will be carried to net revenue account, which is increased by bank interest to a total of £34,485, compared with last year's actual amount of £34,331. The sum of £5,000 will be appropriated from the balance for the relief of rates, whilst the reserve and renewals fund will receive £9,261. Loan repayments will amount to £10,767; interest on loans, £6,277; income-tax on profits, £2,438; Wheatsheaf offices part repayment £400, and car covers £400.

Trafford Park.—Light Railway Inquiry.—On Thursday and Friday last week an inquiry, authorised by the Light Railway Commissioners, was held in Manchester, touching the application of Mr. Marshall Stevens and others—persons concerned with the ownership of land in Trafford Park—for sanction to construct three light railways in and adjoining the Park. The railways proposed were approximately 2 furlongs, 4 furlongs, and 7 furlongs in length, and, on behalf of the applicants, it was stated that they were necessary for the conveyance of the increasing number of workmen who were employed in the Park, and also for goods traffic. At various points tramway rails had been down for years, but no cars had run over them. The application was opposed by the whole of the railway companies, the Manchester Ship Canal, Lancs. County Council, the Stretford District Council, Manchester Corporation, and a number of other public bodies, who urged that the proposed railways were not in the public interest, and alleged that it was the intention of the promoters to give preference to commercial undertakings in Trafford Park over those outside. In the result the application was refused.

TELEGRAPH and TELEPHONE NOTES.

Australia.—Justifying the new telephone charges of 1d. per call for subscribers and 2d. per call on slot machines, the Postmaster-General recently stated that in other countries the rates were much higher, except in Sweden, Switzerland, and Denmark, where labour was cheap. In Australia the average wages paid to the telephone employés, including administration and supervision, were 13·87d. per hour, compared with 9·09d. in America and 6·25d. in England. The cost of the mechanical section in Australia was 21·519d., in England 10·071d., and in the United States 16·20d. per hour. Linemen in Australia received 17·348d., in England 10·071d., and in America 15d. to 17d. per hour.

The Postal Service showed a deficit for the year ended June 30th last of £629,722, compared with a deficit of £501,457 in the previous year; the telegraphs alone made a loss of £106,461 compared with £151,446, and the telephones a loss of £364,109 compared with £296,424.

As the result of a request made by the Professional Officers' Association in Sydney, that the Postmaster-General should give preference to Australians in cases where they were qualified for higher positions in the service, the Postmaster-General has directed that all applicants for an electrical engineership at Adelaide, now vacant, must undergo an examination. Similar examinations will take place in future in the case of other senior positions as they become vacant. This, Mr. Webster thinks, will afford Australians the opportunity they have been contending for.—*The Age.*

Hull.—The accounts of the Corporation Telephone Committee for 1914-15 show income £138,675; working expenses, £95,102; works protection and war bonus, £226; marriage dowries and pensions, and one year's contribution to staff fund, £5,629, a total of £100,957, to which there was added for interest and sinking fund charges, &c., £32,328, a gross total of £133,285, leaving a net balance of £5,390. The loan repayment charges, amounting to £10,689, were for one year in the case of the original undertaking, and as regarded the ex-National undertaking, from the date of borrowing—May 6th, 1914—in compliance with the requirements of the Local Government Board. After paying the expenses caused by the removal of officers from Hull, consequent upon the transfer, and meeting the cost of replacement of switchboard cables, there remains a credit balance of £11,684 in the reserve fund. The capital account shows a net expenditure of £198,183, which included the purchase of the ex-National undertaking, and an amount of £3,664 capital expenditure since January 1st, 1912. The total capital outlay was £313,112.

In submitting a report on the undertaking the engineer (Mr. T. Holme) stated that the accounts in connection with the plant acquired from the Post Office covered a period of 3¼ years. The gross profit amounted to £37,717. He estimated £3,600 as the loss per annum on the Post Office system before the transfer. The main items which turned this loss into a profit on the amalgamation of the two systems were: Salaries of Post Office staff not replaced, £2,500 per annum; profit on Wincolmlee system, £2,500 per annum; loss on 25s. tariff, now abolished, £2,000 per annum. The effect of the war would be to keep the income down and increase the expenditure. But for the war, the increase of income on the amalgamated system would have exceeded £1,000 per annum. The total length of single wire on the system was 43,254 miles. The estimate for 1916-17 returned the profit at £1,030.

Mongolian Telegraphs.—A Russo-Chino-Mongolian telegraphic conference has decided that the telegraphic lines from Kalghan to Urga and Kiakhta, crossing the territory of autonomous outer Mongolia, are to pass into the possession of the Mongolian Government, in conformity with a triple agreement signed in June, 1915.

Torpedo Controlled by Wireless.—A Reuter telegram from Washington, U.S.A., states that wireless control of a coast defence torpedo by an aeroplane has been definitely accomplished, and the Navy Department has asked Congress to appropriate nearly a million dollars to acquire the rights. Aeroplane control makes it possible for the operator to guide the torpedo through the water from any height, air bubbles from the compressed air motor of the torpedo giving him a certain guide to steer it against a ship's hull. No details are available, and the method by which the controlling waves are enabled to actuate the steering gear of the torpedo, in spite of the shielding effect of the shell of the latter, and of the sea-water, is not known.

United States.—The Marconi Wireless Telegraph Co. of America has brought an action against the Detroit and Cleveland Navigation Co. at Buffalo, N.Y., for using infringing apparatus on its steamships.

The antenna of the radio-station of the Atlantic Communication Co., at Sayville, L.I., was brought down by the weight of sleet on December 29th. Repairs were made at once.

The Marconi Wireless Telegraph Co. of America has placed a contract for the erection of a new station building at Cape May, N.J. A tower 140 ft. high will also be erected.

The United States battleship *Wyoming* reports that while she was near Cape Henry, Va., on January 10th, radio-telegraph messages were exchanged with the *San Diego* at Graymas, Mexico, a distance of 2,500 miles.

Recently the Marconi Wireless Telegraph Co. of America brought an action against the American-Hawaiian Steamship Co. for infringement of its "tuning patent," by the use of certain wireless telegraph apparatus manufactured by the Kilbourne & Clark Manufacturing Co., of Seattle, Wash., which had been installed on its steamship *Floridian*. Judge Veeder, on January 8th, granted a preliminary injunction against the further use of the apparatus on the steamship.

Judge Mayer dismissed, on January 7th, the wireless patent infringement suit brought by the receivers of the National Electric Signaling Co. of Pittsburg, Pa., against the Atlantic Communication Co., which operated the Sayville wireless station. It was complained that the defendant had infringed the claims of patents granted to Reginald A. Fessenden, but Judge Mayer held that the claims were invalid.

The Marconi Wireless Telegraph Co. of America has closed a contract with the Inland Navigation Co., New York, for the installation of wireless apparatus on 36 freight barges, which are soon to ply the waters of the Mississippi. The contract provides for 2-kw. Marconi sets, giving a communication range of 400 miles or more. Marconi operators will be supplied and service with land stations provided as in ocean navigation.—*Telegraph and Telephone Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—April 15th. P.M.G. Common-battery multiple switchboard, or automatic or semi-automatic switchboard, and associated apparatus. See "Official Notices" December 31st.

Brisbane.—April 26th. Deputy P.M.G. Five sections of trunk line switchboard for Toowoomba Exchange. (Schedule No. 342.)

Melbourne.—March 22nd. Thermo-electric pyrometers, for the Victorian Government Railway Commissioners.*

April 12th. Electrically operated runway hoist for the Jolimont car shops. Particulars at the contractors' room, Spencer Street.

Sydney.—February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

April 10th. Municipal Council. Supply, laying and maintenance for six months of six 11,000-volt submarine cables, each 400 yards long, across Darling Harbour.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.

Belfast.—February 16th. Corporation. Tramway stores, including cable, lamp and electrical accessories. See "Official Notices" to-day.

Birmingham.—February 8th. Twelve months' supply of electrical stores, for the Birmingham, Tame and Rea District Drainage Board. Forms of tender from the Board's offices, Tyburn, Birmingham.

Exeter.—B. of G. Electric light installation for Block 3 at the workhouse. Particulars from the Surveyor.

Halifax.—February 14th. Corporation. Twelve months' supply of electric lighting fittings and accessories, cables, telephone wire, meters, &c. See "Official Notices" January 21st.

Leigh (Lancs.).—February 18th. Electricity Committee. 2,000-kw. turbo-alternator, 6 600 volts; surface condenser, set of pumps, 1,000-kw. rotary or motor-converter, with switchgear. See "Official Notices" January 28th.

London.—Islington.—February 17th. B. of G. Alteration to wiring, provision of switchboards, motor starters, &c., provision of motors, and purchase of old plant. See "Official Notices" January 28th.

Hammersmith.—February 16th. Corporation. Twelve months' supply of stores, including wires, cable joint boxes, fuse boxes, insulating material and electric light sundries, for the Electricity Department. See "Official Notices" to-day.

Battersea.—February 21st. B.C. Engine-room stores, oils, electricity meters, service joint-boxes, ironmongery, tools, trough-ing, conduits, insulators, coal, &c., for the Electricity Department. See "Official Notices" to-day.

Manchester.—February 15th. Corporation. General stores, including cables, telephones, electrical accessories, &c., for the Tramways Department. See "Official Notices" January 28th.

New Zealand.—Dunedin.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.

Raetihi.—March 14th. Town Board. 40-h.p. hydro-electric generating set, switchboard, &c. Plans and particulars from Messrs. H. W. Climie & Son, Raetihi.*

Wellington.—March 8th. Public Works Office. One 3,000-kw. generator and one 4,300-h.p. water turbine, at Lyttelton, for the Lake Coleridge electric power scheme. Specifications, &c., may be consulted by British firms at the office of the High Commissioner in London for New Zealand, at 13, Victoria Street, S.W.

Pembroke (Dublin).—February 7th. U.D.C. Twelve months' supply of electrical goods. Specifications from the Town Hall, Ball's Bridge, Co. Dublin.

Portsmouth.—February 15th. Corporation. Six months' supply of tramway stores, including insulating materials, lamps, motor windings. See "Official Notices" to-day.

Southampton.—February 19th. Corporation. Twelve months' supply of general stores, electric lamps, &c., for the Tramways Department. Specifications from the Manager, Tramway Offices, 161, Above Bar Street.

Spain.—Tenders have been invited by the municipal authorities of Anzuola (Province of Guipuzcoa) for the concession for the electric lighting of the town.

Todmorden.—February 12th. Electricity Committee. One Lancashire boiler, superheaters, mechanical stokers, pipework, centrifugal pump; also brickwork for Lancashire boiler. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The following tenders have been accepted:—

P.M.G.'s Department, West Australia.

7 miles 763 yards of lead-covered conductor cable, 150 pairs, £1,018 per mile; 4 miles 1,602 yards ditto, 100 pairs, £748 per mile.—Western Electric Co. (Aust.), Ltd.

P.M.G.'s Department, N.S.W.

3½ miles of lead-covered conductor cable, 15 pairs, £101 per mile; 9½ miles ditto, 25 pairs, £132 per mile; 9½ miles ditto, 35 pairs, £165 per mile; 38½ miles ditto, 50 pairs, £228 per mile; 9½ miles ditto, 75 pairs, £294 per mile.—W. T. Henley's Telegraph Works Co., Ltd.

14½ miles of lead-covered conductor cable, 150 pairs, £494 per mile; 1½ miles ditto, 200 pairs, £634 per mile; 5 miles ditto, 250 pairs, £778 per mile; 11½ miles ditto, 300 pairs, £920 per mile.—Western Electric Co. (Aust.), Ltd.

4 miles of lead-covered conductor cable, 400 pairs, £1,185 per mile.—British Insulated & Helsby Cables, Ltd.—*Tenders.*

Barking.—The U.D.C. has accepted the tender of Mr. S. E. Moss, of Southend-on-Sea, for extensions at the electricity works, at £1,200.

Bristol.—The Corporation Docks Committee has accepted the tender of Messrs. W. T. Henley's Telegraph Works Co., Ltd., for 250 yards of 7/18 paper-insulated lead-covered cable.

Derby.—The T.C. has accepted the tender of the British Electric Transformer Co., Ltd., for a transformer, at £110.

Glasgow.—The Electricity Committee recommends acceptance of the following tenders:—

British Westinghouse Co., Ltd.—One 6,000-kw. turbo-alternator and condensing plant, at £25,622, for the Port Dundas station.
Willans & Robinson, Ltd.—One 6,000-kw. turbo-alternator and condensing plant (with Dick, Kerr alternator), at £25,480, for St. Andrew's Cross station.

The above sets are to be completed by September of the present year.

The Tramways Committee has recommended acceptance of the following offers:—

V.I.R. cable.—Liverpool Electric Cable Co.; Pirelli, Ltd.
Commutators.—British Westinghouse Co.

Ilford.—The following offers of coal have been accepted by the Electricity Committee:—

E. Foster & Co.—100 tons Glyncoed through and through, at 24s. 9d. per ton; 100 tons Glyncoed small, at 20s. 10d. per ton; about 150 tons Measham slack, at 18s. 6d. per ton.
Cleeves & Co.—200 tons Notts large hard, at 23s. 9d. per ton.
E. Foster & Co.—Three trucks per week of West Cannock 2-in. nutty slack, at 20s. 10d. per ton, over a period of 12 months.

The Committee has also accepted the tender of the Albion Clay Co. for cable ducts, at 2s. 4½d. per yard.

London.—L.C.C.—The Education Committee has considered a claim from Messrs. Lund Bros. & Co., the contractors for the electric lighting installation at Ocean Street School, Stepney, in respect of the rise in the prices of materials between the time of the acceptance of their tender and the execution of the work. The contract was accepted in December, 1913, and the first portion completed in 1915; the second portion has only recently been commenced, owing to the building trade strike in 1914. The Committee is of opinion that an allowance of £39 should be made in settlement of the claim; and also that the request of Messrs. Defries and Goldman, contractors for installing electric light at Star Street School (Fulham), Victoria School (Hammersmith), Senior Street School (Paddington), and Woolmore Street School (Poplar), for permission to assign their contracts to the Alpha Manufacturing Co., be complied with.

West Bromwich.—The Electricity Committee recommends the acceptance of the tender of Messrs. J. Dallow & Sons, at £8,850, for the erection of the engine-room walls and foundations and brickwork for steel chimney, in connection with the plant extensions at the electricity works; also the tender of the New Conveyor Co. for certain extensions to the coal conveyor.

Windsor.—Messrs. Chamberlain & Hookham, Ltd., have received the contract for the supply of electricity meters for the coming year.

Whitby.—The contract for laying cable and installing the electric light (approximately 65 lights) at Sneaton Castle, for Col. J. W. Richardson, has been secured by Mr. Isaac Stephenson, of Whitby.

FORTHCOMING EVENTS.

Greenock Electrical Society.—Friday, February 4th. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "Colliery Electrical Installations," by Mr. R. Gordon Campbell.

Saturday, February 12th.—Visit to blast furnaces at the Govan iron works of Messrs. Wm. Dixon, Ltd.

London Association of Foremen Engineers.—Saturday, February 5th. At 8 p.m. At Cannon Street Hotel, E.C. Lecture on "Superheated Steam," by Mr. T. Sugden.

Society of Engineers.—Monday, February 7th. At 7.30 p.m. At Caxton Hall, Westminster, S.W. Presidential address by Mr. P. Griffiths. Presentation of premiums.

Institution of Civil Engineers.—Tuesday, February 8th. At 5.30 p.m. At Great George Street, S.W. Paper on "Notes on the Working of a Rack Railway," by Mr. W. T. Lucy.

Liverpool Engineering Society.—Wednesday, February 9th. At the Royal Institution, Colquitt Street. Paper on "The Education of a Marine Engineer," by Mr. J. E. Jeffery.

Association of Engineers-in-Charge.—Wednesday, February 9th. At 7.30 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Multiple-Effect System of Refrigeration," by Mr. W. Stokes.

Royal Society of Arts.—Wednesday, February 9th. At 4.30 p.m. At John Street, Adelphi, W.C. "The Organisation of Scientific Research," by Prof. J. A. Fleming, F.R.S.

Institution of Electrical Engineers.—Thursday, February 10th. At 8 p.m. At Victoria Embankment, W.C. Paper on "The Testing of Underground Cables with Continuous Current," by Mr. O. L. Record.

(**Western Local Section**).—Monday, February 7th. At 5.30 p.m. At the South Wales Institute of Engineers, Park Place, Cardiff. Paper on "The Testing of Underground Cables with Continuous Current," by Mr. O. L. Record.

(**Manchester Local Section**).—Tuesday, February 8th. At 7.30 p.m. At the Engineers' Club, 17, Albert Square. Paper on "The Testing of Underground Cables with Continuous Current," by Mr. O. L. Record.

(**Scottish Local Section**).—Tuesday, February 8th. At 7 p.m. At Prince's Street Station Hotel, Edinburgh. Paper on "The Principles of Modern Printing Telegraphy," by Mr. H. H. Harrison.

(**Yorkshire Local Section**).—Wednesday, February 9th. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "The Testing of Underground Cables with Continuous Current," by Mr. O. L. Record.

Manchester Association of Engineers.—Saturday, February 12th. At the Grand Hotel, Aytoun Street. Paper on "Oil Engines," by Mr. G. E. Windeler.

North of England Institute of Mining and Mechanical Engineers.—Saturday, February 12th. At 2 p.m. At Neville Hall, Newcastle-on-Tyne. General meeting.

THE B.E.A.M.A. ANNUAL MEETING.

THE annual general meeting of the B.E.A.M.A. was held at the Connaught Rooms on Thursday, January 20th. Mr. F. R. Davenport (Willans & Robinson, Ltd.), chairman of the Council, presided, and we learn that there was a good attendance of members.

In submitting the annual report and balance-sheet, the chairman said that notwithstanding the handicaps under which members were suffering due to shortage of labour, difficulties in obtaining materials, Government control, &c., they had, compared with some other trades, no reason to be dissatisfied with the situation.

Public attention was at the present time being largely directed to the question of the probable situation after the war, and several associations purporting to look after that matter and working more or less on parallel lines had sprung up. The B.E.A.M.A. had been invited to join some of these associations, but up to the present had not done so, though they had given considerable time to the exchange of views and the holding of conferences, and were still directing their attention to the efforts made towards creating some central and representative body which would embrace the common interests of all British traders. Suggestions had been made by the B.E.A.M.A. to the Colonial Office that money raised within the Empire should be expended on British goods, and whilst the Secretary of State for the Colonies was unable to give any definite assurance, there appeared now to be a far more favourable atmosphere surrounding the whole question of Colonial and Allied trade.

The Association had been in conference with the Advisory Committee of the Commercial Intelligence Department of the Board of Trade, to whom memoranda had been submitted, many of the recommendations put forward being, the Chairman understood, embodied in the report made by this Committee. That looked as if things were tending in the right direction. They had been in conference with the Government Research Committee, which was appointed by the Board of Education to inquire into the broad question of scientific and industrial research and for the granting of sums of money in aid of research. Although he had nothing to say at the moment as to probable results, their Committee was a strong one, and there was every sign that good results would flow from the effort. With a view to organising and extending the export work of members, additions had been made to the export staff, and Overseas Committees had been appointed in India, Australia and South Africa. Others, it was hoped, would be shortly appointed. The *Beama Journal*, which had a wide overseas circulation, was used by members as a publicity missionary for export trade, and, with the object of discussing ways and means of bringing about co-operative effort, both in the home and export sides of the industry, which were, of course, very intimately interlinked, recently a series of informal evening gatherings had been held. As the report told them, home conditions of contract and standardisation still remained amongst their fundamental activities, and they had been actively engaged in these directions. He thought they might say, without any undue pride, that their position as an Association, both nationally as well as in relation to their own trade circles, had been strengthened without in any sense alienating, as far as he was aware, customers' minds and their general opinion of the B.E.A.M.A.

In the discussion which followed, MR. LUNDBERG (A. P. Lundberg & Sons), MR. LONGBOTTOM (Electromotors, Ltd.), and MR. BERRY (Berry, Skinner & Co.) referred to the unsatisfactory position in regard to patents. Practically all members were now controlled firms, and their patents were naturally in a state of suspension, although patent fees had to be paid. This meant that the useful life of the patent would be shortened by the duration of the war. It was considered that notwithstanding the unsympathetic attitude of the Board of Trade the matter should be persevered with.

The report was adopted.

Messrs. Callender's Cable and Construction Co., Ltd., were elected members of the Council.

NOTES.

Two Interesting Problems.—The Christmas number of the *Wireless World* contained the following solutions to the cube problem (which we reproduced in our last issue), by a correspondent, Mr. W. B. Ferguson :—

If the cube be imagined to be pulled apart from points *e* and *c*, fig. 1, all confusion at once vanishes, as the cube assumes the shape shown in fig. 3, from which it is obvious at a glance that we have three in parallel (W-X) in series with six in parallel (X-Y) in series with three in parallel (Y-Z); therefore the resistance from *e* to *c* is one-third plus one-sixth plus one-third. Answer: Five-sixths of an ohm.

Alternative Problem (sides made of 1-ohm sheets).—In fig. 1 the current entering at *e* divides equally between top, front, and left side (*a b f e*; *e f g h*; *e a d h*), each of 1-ohm resistance, therefore one-third of an ohm total. The current leaves by three sheets—bottom, back, and right side (*c d h g*; *c d a b*; *c b f g*), each of an ohm resistance, therefore one-third of

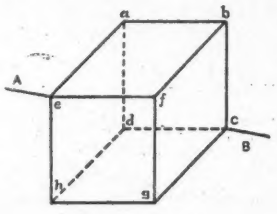


FIG. 1.

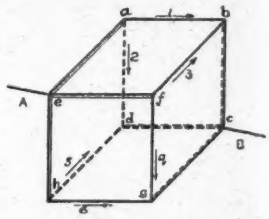


FIG. 2.

an ohm total. The first set of sheets joins direct with the second lot of sheets along the line *a*, *b*, *f*, *g*, *h*, *d*, *a*; therefore we have one-third of an ohm in series with one-third of an ohm. Total, two-thirds of an ohm.

We have received from Mr. W. N. Y. King, A.C.G.I., solutions on similar lines, leading to the same conclusions.

With regard to the second part of the cube problem, although both solvers arrive at the same result, we are unable to agree that the solution is correct. In point of fact, on consideration of the conditions—a cube constructed of sheet metal, with current led in and out by diagonally opposite *corners*—we have come to the conclusion that the problem is one of considerable difficulty. The solvers appear to assume that the resistance of one side is one ohm, no matter in what direction the current passes through it, but this

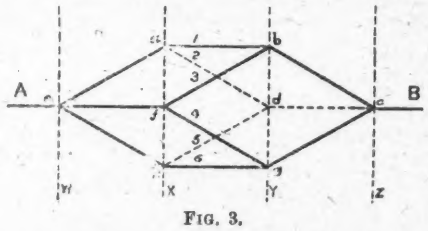


FIG. 3.

is clearly an inadmissible assumption. It must, of course, be taken that the sides are in contact along every edge; and the resistance of each side from edge to edge is 1 ohm—if it is taken diagonally it becomes indeterminate.

As the solution to the second problem (the two steel rods) will be published by our contemporary this week, we shall not be guilty of discourtesy if we include it here :—Gently apply one end of bar A to the middle of bar B, and separate the bars again. If there is magnetic attraction between them, as indicated by "stickiness," A is the magnet; if no attraction is felt, obviously A is not magnetised, and, therefore, B is the magnet. A symmetrically magnetised bar, having two poles only, has no external magnetic field at its median plane. Mr. King solved this problem correctly.

"Jitney" Competition in America.—Full reference has recently been made in our "City Notes" to the serious effect of unlicensed jitney 'bus competition upon the traffic of the British Columbia Electric Railway Co., Ltd., a competition which may have far-reaching results, including the closing of some of the tramway sections. We now read in the British Consular Report for the district of Portland, Oregon, U.S.A., that this kind of service has also been making its influence severely felt in other places as well, and has got to be reckoned with in the future. The writer of the report says that in the last six months of 1914 the street car service of most of the United States, but especially on the Pacific Coast, was hard hit. "In Portland the company that has control of the street railways and supplies most of the electric current for household and commercial purposes, mostly consists of Eastern States capital, and is not so much affected by loss in passengers on the cars, as that is only part of the revenue, but companies which have no other earning power are very much affected. A few months ago a number of automobiles of different makes, sizes and conditions started to compete for the passenger service on the streets where cars run. It was vulgarly termed the 'Jitney' service, after a name given to the 5 cent. (2½d.) coin used, and grew with leaps and bounds, as many people who used automobiles to get to work, and for occasional business journeys during the day, would put up a sign for passengers on their way to work and in the evening home. Some women who own automobiles, and have no house or family, have gone into the business, which the city authorities are now endeavouring to regulate, as the loss in revenue to the city is quite great, and some of the 'Jitney' drivers are incompetent and wild. The new system is a great comfort to many people, because, as soon as a car, say, carrying five persons, is filled, they take short cuts through the residential district, not being interfered with by the car tracks and heavy wagons on the main streets, and a man reaches his office or home in half the time he would on a street car, and, if convenient to the others in the car, can on wet days be put off at his office or house. One result of the 'Jitney' outbreak has been the faster running of the street cars, which formerly were very trying to a nervous man who was in a hurry. Many people interested in this new business say that the big heavy automobiles with a large carrying capacity will soon die out from the expense of fuel and upkeep, while the cheap car, built for economy and carrying from four to seven passengers, will make a living for their drivers and expenses. The cost of taxicabs here is very great. Many of the 'Jitneys,' neat looking cars, can be hired for a trip to the station for about a quarter what the taxicabs charge, and for less than half by the hour for an afternoon's trip, so it is to be hoped that the regulations on them will not be too severe. One regulation suggested that all licensed 'Jitneys' must have the name of their route painted on them, must keep on a fixed route, must not run on a street where a street car runs, not get off the route laid down, and all be at work from 6 to 10 a.m., and from 4 to 11 p.m., notwithstanding weather or sickness of owner, who is generally driver. Investors in such undertakings as street railroads must look forward to the changes in methods of transportation, and are likely to suffer, as their predecessors the horse-tram, 'bus and cab companies did."

Institution and Lecture Notes.—Illuminating Engineering Society, U.S.A.—This Society holds its mid-winter convention in New York, on February 10th and 11th. The programme of papers includes the following:—Relation of Lighting to Architectural Interiors; Candle-Power Measurements of Series Gas-Filled Incandescent Lamps; Theatre Lighting; Illuminating Engineering Photographs; The Lighting of Important General Offices in New York City; An Interlaboratory Photometric Comparison of Glass Screens and of Tungsten Lamps, involving Colour Differences; The Box Photometer; and a Lecture on the Lighting of the Panama Pacific Industrial Exposition.

Wolverhampton and District Engineering Society.—On Friday last, Mr. C. Jones, chief electrical engineer to the Cannock Chase Collieries, gave an interesting lecture to the Society on the application of electricity to the working of collieries.

Nottingham Society of Engineers.—At a joint meeting of the Society with the Association of Mining Electrical Engineers, Mr. R. A. Sheldon read a paper on the use of electricity in conveying coal from the working face to the pit-head.

Leeds Association of Engineers.—At a meeting on Thursday last week, Mr. G. Wilkinson, electrical engineer to the Corporation of Harrogate, read a paper on the use of electricity as a means of conserving our coal measures; he pointed out that the enormous drain upon the Empire in men, money, and materials, occasioned by the war, had emphasised the need for thrift and economy in all directions. One of this country's chief assets was coal, and economy in its use and consumption was very needful. About one-tenth of all the coal raised in these islands was burned in private fires. A great saving could be effected at once by abandoning the wasteful open fire in favour of other more economical forms of heating, such as hot-water radiators. On banishment of the open fire, the supplemental heating of the living rooms would take the form of electric fires or gas stoves, thus effecting great economy both in fuel and in labour.

Belfast Association of Engineers.—On January 21st an address was delivered by Mr. W. Pleasance, on "Three-Phase Current for Power Purposes." The lecturer dwelt on the advantages of the three-phase system as compared with direct current for power and lighting, and a discussion followed. According to the *Belfast News-Letter*, the Chairman, Mr. J. W. Kempster, said that, broadly speaking, they ought never to put in a D.C. machine if they could put in three-phase plant; but they must give due weight to the purpose in view, and not install three-phase merely for the sake of three-phase. Individual driving in an engineering works he said, was undoubtedly the most economical in the end. The introduction of electrical driving was one of the ways in which they would have to make good the wastage of capital caused by the war; properly applied, it enabled them to get the utmost possible out of the man and the machine, and greatly increased the productivity of their factories and workshops.

Decimal Coinage.—In our contemporary *Nature* for January 20th, a writer using the initials "G. H. B.", who is clearly an ardent supporter of the metric system, takes us to task because, in our recent article on "Decimal Coinage and the Metric System," we "associated these undoubted claims for standardisation of units with the advocacy of a change of monetary system which nobody understands, and which does not appear calculated to advance the cause of international uniformity." He goes on to say that the result of our inquiries of business firms was "a very thorough discussion of the advantages of the metric system, and the absence of any substantial evidence regarding the monetary question," and afterwards demonstrates that the decimal system of weights and measures in international use is based on a distinctive and unique nomenclature for tens, hundreds, thousands, and corresponding submultiples of the fundamental unit, whereas most systems of coinage are centesimal, and chaotic at that.

Our critic, who has evidently only glanced at parts of the article in question, omits to mention that we explicity stated in several places that we regarded the adoption of the metric system in this country as of the first moment, and that the adoption of decimal coinage was an independent question of secondary importance, its chief recommendation being economy of clerical labour. Apparently "G. H. B." bases his sweeping statement to the effect that "nobody understands" the system upon his own lack of comprehension of it, which is a somewhat shaky foundation; but we did not advocate decimal coinage with a view to international uniformity in this respect, an ideal which is obviously unattainable. The writer goes on to dilate upon the disadvantages of such uniformity of coinage, thus unconsciously supporting our proposal that we should *not* adopt the franc or anything of equivalent value, but should base our system upon the pound sterling and its decimal submultiples, the florin being about twice the value of the mark, and two and a-half times the value of the franc, lira, &c. He further supports our contention that the exchange value of an English sovereign is known all over the world, and states that our manufacturers can at present give their quotations in decimals of a pound—yet he does not seem to understand that the system we propose achieves precisely that very end, without the necessity of reducing shillings and pence to decimals of a pound!

Instead of realising that the present is an ideal time for introducing a change in coinage, when our normal standards of value have gone overboard, and the slight change of 4 per cent. in the value of *copper coins only* would be unfelt, "G. H. B." thinks "it is quite clear that any such change would lead to a state of chaos in our international trade"—although he has himself stated that the value of the sovereign is known all over the world, and our proposal is to convert our coinage to sovereigns and decimals of a sovereign, which, he says, can easily be done! If "G. H. B.'s" arguments are to have any weight, they should be less at war with one another; a writer who puts forward statements on the "it-is-quite-clear" basis, when his own arguments demolish one another, and exhibit a confusion of thought deplorable in one who assumes the office of a critic, can hardly hope to secure the approval of anyone but his adversaries.

Fatalities.—An inquest was held at Leigh, on Thursday last week, on Richard Tinsley, aged 45, an electrician employed at the Bickershaw Collieries of Messrs. Ackers, Whitley & Co., who met with a fatal accident at the pit on the previous day. He had been engaged in repairing some wire in the 7-ft. shaft, about 10 yards below the surface, and, according to the evidence of Henry Collier, assistant electrician, the job had been finished. They told the banksman they had done with the cage. A few minutes later it was lowered, and Collier heard a crash. The cage was stopped and brought to the surface. The body was subsequently recovered from the sump-hole in a mutilated condition. A verdict of "Accidental death" was returned.

The Burnley Coroner held an inquest, on January 24th, concerning the fate of Alfred Dixon, of Manchester, foreman electrician for the L. & Y. Railway Co., who was knocked down by a train near Gannow Junction. Deceased was repairing some of the wires close to Gannow Junction when the fatality happened. He had been employed by the Railway Co. for 21 years on this class of work. The jury returned a verdict of "Accidental death."

Municipal Employés and Compulsory Service.—At the meeting of the Birmingham City Council on Tuesday last, the General Purposes Committee recommended that the privileges granted to the officers and servants of the Corporation who had joined the naval and military services should be extended to those men who were taken by compulsion for service. An amendment was moved by Alderman Davis that the report be referred back for further consideration. He submitted that the Corporation would not be keeping faith with those men who had voluntarily enlisted if equal advantages were given to those who were conscripted. This was the feeling of the majority of the Council, and the amendment was carried.

Appointments Vacant.—Junior engineers-in-charge (42s.), and switchmen (35s.) for the Newport Corporation Electricity Department. See our advertisement pages to-day.

Electrical Rain-Making.—The Committee appointed by the N.S.W. Premier to inquire into Mr. Balsillie's proposals for causing rain by electricity has now reported. The essential features of the proposal were the use of an electrically charged, metal-coated captive balloon, the suspending of a Rontgen-ray tube from it, and the combination of the electrically-charged body and the Rontgen-rays. The Committee reports that after experiments it was not satisfactorily established that Mr. Balsillie had succeeded in making any definite advance towards attaining practical results, but recommends further investigation of the subject, with a view to the carrying out of open-air experiments in New South Wales.—*Sydney Evening News.*

Volunteer Notes.—Engineering Institutions' Volunteer Engineer Corps.—Orders for week commencing February 7th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Sunday, February 6th.—Trench Work Train, 9.33 a.m. Cannon Street.

Monday, February 7th.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, February 8th.—School of Arms, 6 to 7 p.m.

Thursday, February 10th.—Shooting for Sections 1 and 2 and Signalling Class.

Friday, February 11th.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, February 12th.—Uniform Parade, 2.45 p.m.

Sunday, February 13th.—Signalling Section. For particulars see Notice Board.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Regiment (Volunteers).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, February 3rd, 1916:—

Week-end Parades.—Saturday—The Battalion, less Platoons Nos. 8, 11, North London and Blackheath, will parade at Wembley Park at 3.15 p.m. "Derby" recruits are invited to attend.

Sunday.—(The first Sunday in the month).—Field Operations. The Battalion will parade at 9.30 a.m., at King's Cross Station, G.N.R., and proceed to Hatfield Park. Members are requested to purchase their tickets before the hour appointed for parade, and to provide themselves with White hat-bands. Lunch will not be provided by the Corps, but the Quartermaster will make arrangements to provide light liquid refreshments. The 3rd Battalion Herts. V.T.C. have kindly arranged to provide Tea, at a very small cost, after the Operations.

The Battalion will return to town at 5.22 p.m.

Musketry.—The Inter-Platoon Competition will be continued at the Acton Range on Saturday next, the 5th inst., in accordance with the orders published on Monday last. The competing platoons Nos. 8, 11, North London and Blackheath, to parade punctually at 1.30 p.m. in uniform with bayonets.

A. G. Joiner, *Major and Adjutant*, O.B.C.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Preston Corporation has appointed Mr. H. Alston, of Blackburn, to the position of chief traffic clerk in the tramways department.

Mr. F. Mawdesley, assistant engineer at the Plumstead electricity works of the Woolwich Borough Council, has been promoted acting charge engineer at £110 per annum.

Mr. J. Dugdale, the Oldham Corporation tramways manager, who, as recently reported, met with an accident at Rotherham, has now returned to Oldham.

General.—The Curtis Manufacturing Co., Paddington, inform us that their principal, Mr. F. C. Curtis, after putting in seven months' signal work with the Royal Naval Division, R.E., in the trenches at Gallipoli, is now at —— in charge of the motor cycle maintenance for the Division. The company's business is being carried on as usual in his absence.

The *London Gazette* Territorial Force cancellation notice which, in our last issue, was bungled by the printer when making corrections, should have read as follows:—"Captain (temporary Major) Arthur E. Levin; Second-Lieutenant (temporary Captain) George L. L. Russell; Lieutenant (temporary Captain) Hugh C. C. Tufnel; Second-Lieutenant (temporary Lieutenant) Frederick H. Bowers."

The marriage has taken place at Luton of Mr. Wm. Thos. Godden, chief electrician at the Royal Naval Hospital at Chatham, and Miss Alice Molland.

The marriage took place on January 22nd, at St. Botolph's Church, Bishopsgate, E.C., of Sapper Bertram Goddard, electrical engineer, of the London Electrical Engineers, and Miss Gladys Raison, of Woodford.

From the *London Gazette*:—"Territorial Force: Royal Engineers. *Tyne Electrical Engineers.* To be Second-Lieutenants on probation:—W. W. Wilson; Private J. B. Murray, from the Artist Rifles O.T.C."

Mr. L. W. Phillips, A.M.I.E.E., late of the technical staff of the Edison & Swan Laboratory, Ponder's End, has been appointed manager of the advertising and publicity department of the Electrical Supplies Co., of Tottenham Court Road, London, W.

On Saturday, March 4th, a wedding will take place, very quietly, at Herne Hill, between Henry Cobden Turner, of the British Westinghouse Co., Ltd., Trafford Park, son of Mr. Wilberforce Turner, of Westbrook, Eccles, and of Bare, Morecambe, Lancs., and Elizabeth Anderson (Bessie), daughter of Mr. William Noble, assistant engineer-in-chief of the G.P.O., of Roselea, Burbage Road, Herne Hill, S.E.

Councillor Jas. O'Neill has been re-elected chairman and Councillor McGuinness has been elected vice-chairman of the Dublin Corporation Electricity Committee.

Roll of Honour.—The February number of the *Journal* of the Institution of Electrical Engineers contains a list of awards to members and students for service in the field as follows:—

Lieutenant-Colonel J. C. Chambers, member, and Brigadier-General A. M. Stuart, member, have been made Companions of the Bath.

Major F. J. Chapple, assoc. member, Major S. H. Cowan, assoc. member, Captain A. E. Davidson, assoc. member, and Captain H. M. Leaf, member, have each received the D.S.O.

Lieutenant-Commander E. G. Robinson, assoc. member, was awarded the V.C. last August for conspicuous bravery in Gallipoli.

The Military Cross has been conferred upon:—Second-Lieutenant C. H. Goulden, assoc. member; Lieutenant H. R. L. Groom, graduate; Lieutenant H. J. Gwyther, student; Captain H. P. T. Lefroy, assoc. member; Lieutenant I. W. Massie, assoc. member; Lieutenant A. Podmore, assoc. member; Second-Lieutenant O. W. Sherwell, student; Lieutenant A. R. Tabor, student; and Second-Lieutenant G. W. Williamson, assoc. member.

The Distinguished Service Cross was won by Lieutenant E. G. Boissier, assoc. member.

The D.C.M. has been awarded to Private A. M. Doig, assoc. member; Private P. J. Wood, student; and Corporal C. W. Saunders, graduate.

Sapper J. H. Murray, assoc. member, has received the Distinguished Service Medal.

Seventeen gentlemen in the different classes of membership have been mentioned in dispatches.

The *Journal* contains a further list of members on military service, with particulars of promotions, transfers, &c.

Second Corporal H. E. Govett, of the 67th Field Company, Royal Engineers, reported killed in action in Gallipoli, was for several years engaged with the British Thomson-Houston Co., Ltd., at Rugby, and when he enlisted was on the staff of the testing department.

Corporal Horace Powell, of the 9th Battalion King's Royal Rifles, who was, before the war, on the Rugby staff of the British Thomson-Houston Co., Ltd., is reported missing.

Rifleman T. A. Taylor, of the 21st London Regiment, and late of the staff of Messrs. Siemens Bros., of Charlton, S.E., has been mentioned in dispatches for gallant conduct at Loos.

Private A. V. Pipe, of the 1/20th London (Woolwich and Blackheath) Regiment, who was with Messrs. S. W. Gibson and Co., electrical engineers, of High Street, Dartford, is officially notified to have been killed in action on May 26th last. For many months he had been posted as "wounded and missing."

Private Hugh Kaudy, of the 11th Battalion Manchester Regiment, who has died from dysentery contracted at Gallipoli, was employed prior to the war by the Lancashire Dynamo Co., Ltd., Trafford Park.

Private J. E. Peppin, of the 7th Lancashire Fusiliers, who, prior to the war, was employed at the British Westinghouse Works, Trafford Park, has been killed in action.

On Monday, the Deputy Lord Mayor of Manchester presented Private J. O'Connor, of the 8th Manchesters, formerly employed in the tramways department, with the D.C.M., which he has won for conspicuous gallantry under heavy fire.

Obituary.—Mr. H. M. O'Kelly.—"Nature" states that the death is announced, at the age of 69 years, of Mr. H. M. O'Kelly, formerly superintendent of Government telegraphs in India. He joined the Indian Telegraph Department in 1866, was appointed superintendent in 1886, and retired in 1898.

Colonel Robert Hamilton Vetch.—The *Morning Post*, announcing the death of Colonel Robert Hamilton Vetch, late of the Royal Engineers, at the age of 75, states that an interesting incident in his life occurred in 1869, when he was sent by the Government in the *Great Eastern* to report on the laying of the French Atlantic cable from Brest to St. Pierre and thence to Duxbury, Mass.

Will.—The late Mr. G. A. Scott, a director of the North of Scotland Electric Light and Power Co., Ltd., left £14,533.

NEW COMPANIES REGISTERED.

W. J. Burroughes and Sons, Ltd. (142,842).—This company was registered on January 26th, with a capital of £5,000 in £1 shares, to take over the business of a heating and lighting engineer carried on by W. J. Burroughes, at 143 and 144, Holborn, E.C., as W. J. Burroughes and Sons, to carry on the business of heating, ventilating, and electrical engineers, plumbers, manufacturers of and dealers in appliances, etc. The subscribers (with one share each) are: W. J. Burroughes, 143 and 144, Holborn, E.C., engineer; and S. H. Burroughes, 143 and 144, Holborn, E.C., engineer. Private company. The number of directors is not to be less than two or more than five; the first are W. J. Burroughes (permanent governing director, special qualification, 1,000 shares) and S. H. Burroughes. Qualification of directors, 400 shares. Remuneration of governing director; £500 per annum. Registered office: 143 and 144, Holborn, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Torpoint Electric Supply Co., Ltd.—Particulars of £1,500 debentures created January 4th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £220. Property charged: The company's property, present and future, including uncalled capital. No trustees.

Costa Rica Electric Light and Traction Co., Ltd. (56,447).—Capital, £130,000 in £1 shares. Return dated January 5th, 1916. All shares taken up; £7 paid; £129,993 considered as paid. Mortgages and charges: £286,650.

CITY NOTES.

London and Suburban Traction Co., Ltd.—The directors have declared a dividend at the rate of 5 per cent. per annum on the cum. pref. shares for the past half-year.

Blackpool and Fleetwood Tramroad Co., Ltd.—A final dividend of 4½ per cent. per annum, making 6½ per cent. for the year, is recommended, placing £615 to depreciation reserve, £5,499 to general reserve, writing down investments £995, carrying forward £4,250.

Traction and Power Securities Co., Ltd.—The directors recommend a dividend of 4s. 6d. per share, free of income-tax, on the ordinary shares for the year.

India.—The United Provinces Electric Supply Co., Ltd., is the name of a new undertaking which has lately been formed in Calcutta with a capital of 1,550,000 rupees.

South London Electric Supply Corporation, Ltd.—The directors have declared, subject to final audit, a dividend on the ordinary shares at the rate of 5 per cent. per annum for the year 1915, with a carry-forward of £2,900. Last year the dividend was at the same rate.

Yorkshire Electric Power Co.—Dividend on the ordinary shares, 1 per cent. for 1915.

National Gas Engine Co., Ltd.—Dividend on the ordinary shares, 7½ per cent. for 1915.

Winnipeg Electric Railway Co.—Dividend, 2 per cent. for the quarter ended December, 1915.

City of Buenos Aires Tramways Co. (1904), Ltd.—Balance dividend of 1s. 3d., making 5 per cent. for the year.

Metropolitan Railway Co.—The directors announce a dividend upon the ordinary stock for the past half-year at the rate of £1 per cent. per annum, making 1 per cent. for the year.

STOCKS AND SHARES.

Tuesday Evening.

The latest departure—it will no longer be latest at the end of this week—is the removal of minimum prices from several scores of stocks in the Colonial market which, since the opening of the Stock Exchange, have been protected in this manner by the Treasury regulations. Its effect upon the other parts of the Stock Exchange is marked by dulness in most gilt-edged securities, in consequence of the widening of the area of choice thrown open to the investor.

Home Railway gilt-edged stocks are still hedged round by the minimum prices, as are also a few Government stocks; and strong criticism is launched against the Treasury for not carrying out their plan at one fell swoop. Retention of minimum prices in the cases quoted simply serves to accentuate the confusion and uncertainty that were bound to arise; and if the Treasury had done away with the minima at one operation, it would have been better for investment all round.

The first of the electricity supply companies' dividends are now announced. The Westminster Co. is paying at the rate of 9 per cent., which gives 7 per cent. for the year—a reduction of 2 per cent. as compared with this time in 1915. The St. James' and Pall Mall has brought its year's dividend up to 8 per cent.—a reduction in this case also of 2 per cent. The other West End companies are expected to follow suit, and for some such falling away as this the market has been prepared by intelligent anticipation.

Prices have not moved at all. If dealers are asked how it happens that the quotations keep so comparatively steady, the answer always is that it was thoroughly well recognised that reductions of this sort could hardly be avoided. At the same time, the effect has been to make the shares a little more difficult to sell than they were previously; and probably, by the time that all the companies have announced their dividends, the changes in prices caused by the declarations will be practically nil. On the other hand, it is hardly likely that people will be eager to buy the shares, having regard to the lowered rate of return and the competition which it meets from Government borrowings.

Home Railway dividends are also beginning to make their appearance, and that of the Metropolitan was one of the first to be posted. The company is paying at the rate of 1 per cent., making 1 per cent. for the year, which is ½ per cent. less than that for the corresponding twelvemonth. The price of the stock gave way, and Districts dropped in sympathy. Metropolitan Surplus Lands receives 2½ per cent., the same as usual. Underground Electrics, however, have kept firm, notwithstanding depression in the prices of the Home Railway market as a whole, and the company's 6 per cent. income bonds maintain a very steady position about 83½.

The London & South-Western started its extended electrified train system on Monday, and, as it happened, could scarcely have chosen a more inauspicious day, having regard to the darkened conditions under which trains had to run in the evening in consequence of the Zeppelin visit to the provinces. The only people who failed to see a rather humorous side to the business were the travellers using the line during the affected hours. One of the most inexplicable developments to the ordinary layman was the stoppage of the lifts at some of the stations on the City & South London, but this was not the only thing which gave rise to some wonderment on that evening.

Brazil Tractions have gone back to 51½, although as this is ex dividend, the actual fall is trifling. The company is doing well, and for the eleven months to the end of last November the published earnings show an increase over those of 1914 of two million milreis. Even with the exchange as low as 11½d., it is thought that the company will be able to maintain 4 per cent. dividend, at any rate, which would give a return of 7¾ per cent. on money invested at the present price.

The Canadian and American power companies are mostly doing well, good November statements being issued, *e.g.*, by Shawinigan Water & Power, Mississippi River Power, and Pennsylvania Water & Power companies. There is not much business passing in these; but when the Americans have bought their own railway stocks up to comparatively small-yielding levels, the prosperity of the States will undoubtedly bring industrials to the fore and may easily cause active demand for this class of investment.

Americans during the last few days, however, have been on the dull side—partly because of labour troubles, partly because of President Wilson's brave words to Germany. Not that anybody on this side pays much heed to the latter, but the Americans themselves have stopped buying shares for a time, probably because the prices which most of the active securities have attained are already high enough. American Marconis have gone back with the rest of the list, reacting to 16s., while Canadians are also a dullish spot at 6s. 3d.

Anglo-American Telegraph preferred has risen a point. Eastern Extensions are ½ up, and so are Globe ordinary. The debenture stocks in this section are lower: this is due to the removal of the minimum prices, as mentioned in the first paragraph. With Colonial Government stocks reduced to figures at which they pay 5½–5¼ per cent. on the money, industrial securities have had to come down in sympathy. In favour of the latter, it may be pointed out that in most cases they are irredeemable, whereas the others are terminable at fixed dates. This will give the first-mentioned class a decided advantage in the days when money becomes cheap and investment stocks start to rise once more. For the time being, however, it is bound to weigh heavily upon fixed-interest stocks, particularly of the kind to which industrial debentures belong.

The Mexican position is no better, so the prices for Mexican utilities are again easier. With President Wilson's mind concentrated upon the European War, it is thought that he will have no time to carry out any constructive policy of amending Mexican conditions. Therefore all of the stock and shares connected with the country are weak, and in too many cases unsaleable.

British Westinghouse preference have gone back 1s. 3d. to 43s. upon more cautious views prevailing as to what the next dividend is likely to be. Henleys rose 5s. to 13½, and Telegraph Constructions are £1 up at 36, this market as a whole being a strong one. Iron and Steel shares throughout are firmly held.

The armament section is in more favour. Rubber shares gave way with the price of the raw product, the latter dropping below 3s. and causing some of the recent optimists to take sudden fright, and to sell their shares. At the same time, the decline in rubber brought about a cessation of the buying, with the result that business fell away to a fourth or fifth of what it was ten days ago. The check will do no harm, if it helps to nip in the bud the gambling spirit that was on the increase day by day; and the proprietors of shares in good-class rubber companies need feel no anxiety on the score of their concerns doing excellently well though rubber may drop to half-a-crown per lb.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Feb. 1, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.				
Brompton Ordinary	10	7½	—	£6 13 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	3½	—	7 2 10
do. do. do. 4½ Pref.	4½	5½	—	6 0 0
do. do. City Pref.	4½	3	—	7 10 0
do. 4 Deb.	4	75	—	5 6 8
Chelsea	5	4	—	6 5 0
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 8
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	98	—	5 2 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 8
do. do. 1st Deb.	4½	85	—	5 5 0
do. do. 2nd Deb.	4½	83	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅝	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	5½	2½	—	7 15 7
do. 4½ per cent. Pref.	4½	3	—	7 10 0
do. 4½ Deb.	4½	85	—	5 6 0
do. 5½ Deb.	5½	70	—	5 0 0
St. James' and Pall Mall	10	6	—	8 6 8
do. do. 7 per cent. Pref.	7	6	—	6 16 8
do. do. do. 5½ Deb.	5½	70	—	5 0 0
South London	5	3⅜	—	7 5 6
South Metropolitan Pref.	7	1⅛	—	6 14 0
Westminster Ordinary	9	6	—	7 10 0
do. 4½ Pref.	4½	4	—	5 12 6
TELEGRAPHS AND TELEPHONES.				
Anglo-Am. Tel. Pref.	6	100½	+1	5 19 0
do. Def.	33/6	21⅜	—	7 14 3
Chile Telephone	8	6⅜	—	6 10 8
Cuba Sub. Ord.	5	7⅜	—	6 9 0
do. Pref.	10	14⅜	—	6 18 0
Eastern Extension	7	12⅜ xd	+ ⅛	*6 5 0
do. 4 Deb.	4	75	−¼	5 6 8
Eastern Tel. Ord.	7	127½ xd	—	*6 5 0
do. 8½ Pref.	8½	64½	—	5 8 6
do. 4 Deb.	4	75	−¼	5 6 8
Globe Tel. and T. Ord.	6	10½	+ ⅛	*6 10 6
do. Pref.	6	10½	—	5 17 1
Gt. Northern Tel.	22	88⅜	—	6 10 4
Indo-European	18	49	—	6 15 4
Marconi	5	1⅛	—	5 8 1
New York Tel. 4½	4½	100⅞	—	4 9 1
Oriental Telephone Ord.	10	1⅜	—	5 6 8
do. Pref.	6	⅝	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	5	5⅞	—	*7 19 0
do. Pref.	5	4⅛	—	5 8 1
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12⅝	—	*6 4 6
do. 4 Deb.	4	77 xd	−2	5 4 0
HOME RAILS.				
Central London, Ord. Assented	4	69	−1	5 16 0
Metropolitan	1⅓	24⅜	— ⅜	5 2 0
do. District	Nil	15	— ⅛	Nil
Underground Electric Ordinary	Nil	1⅛	— 1/16	Nil
do. do. "A"	Nil	6/6	—	Nil
do. do. Income	6	83½	+ ½	*8 4 0
FOREIGN TRAMS, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	95	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4½	—	6 13 6
do. 2nd Pref.	5½	8⅜	—	8 3 0
do. 4 Deb.	4	71	—	5 12 8
do. 4½ Deb.	4½	77	—	5 17 0
do. 5 Deb.	5	80	— ½	6 5 0
Brazil Tractions	4	61½ xd	— ½	7 15 4
Bombay Electric Pref.	6	10 xd	—	6 0 0
do. 4½ Deb.	4½	85	—	5 3 0
British Columbia Elec, Rly. Pfce.	5	58	−1	8 9 6
do. do. Preferred	—	38	−2	Nil
do. do. Deferred	—	34	−1	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams	Nil	39	—	Nil
do. 5 per cent. Bonds	—	45	−1	Nil
do. 6 per cent. Bonds	—	58	−1	Nil
Mexican Light Common	Nil	29	—	Nil
do. Pref.	Nil	38	—	Nil
do. 1st Bonds	—	45	−2	—
MANUFACTURING COMPANIES.				
Babcock & Wilcox	14	21½	—	5 4 1
British Aluminium Ord.	5	22/6	—	4 9 0
do. Pref.	6	18/-	—	6 13 4
British Insulated Ord.	15	10½	—	7 2 10
do. Pref.	6	6½	—	5 11 7
British Westinghouse Pref.	7½	43/	−1/8	6 19 4
do. 4 Deb.	4	69	—	5 14 10
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11½	—	6 13 4
do. 5 Pref.	5	4½	—	5 17 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	2½	—	6 8 0
Edison & Swan, £3 pd.	Nil	7/6	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	60	—	6 13 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	15/-	—	8 0 0
do. Pref.	7	1	—	7 0 0
Gen. Elec. Pref.	6	3½	—	6 3 1
Henley	20	18½	+ ½	*8 6 2
do. 4½ Pref.	4½	4½	—	5 6 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	10	9½	—	*12 19 0
Telegraph Con.	20	36	+1	*7 12 6

*Allowance made for dividends being paid free of income-tax.

Electric Industrial Vehicles in the U.S.—According to some information just to hand, there are at present no fewer than 24 concerns in the United States building electrical motor vehicles of the industrial type. The number of different models constructed is 53, ranging in capacity from 7 cwt. to 9 tons.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, February 2nd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	..	..
a " Nitric	"	..	..
a " Oxalic	per lb.	1/4	..
a " Sulphuric	per cwt.	..	..
a Ammoniac Sal	"	..	..
a Ammonia, Muriate (large crystal)	per ton	£54	£4 inc.
a Bleaching powder	"	..	..
a Bisulphide of Carbon	"	£23	..
a Borax	"	£25	..
a Copper Sulphate	"	£45	..
a Lead, Nitrate	"	..	..
a " White Sugar	"	..	..
a " Peroxide	"	..	..
e Methylated Spirit	per gal.	..	..
a Potassium, Bichromate, in casks	per lb.	..	..
a Potash, Caustic (88/90 %)	per ton	..	..
a " Chlorate	per lb.	1/8	..
a " Perchlorate	"	1/6	..
a Potassium, Cyanide (98/100 %)	"	Nom.	..
(for mining purposes only)			
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	"	£11 10	..
a " Recovered	"	..	..
a " Lump	"	£9	10/- inc.
a Soda, Caustic (white 70/72 %)	"	..	..
a " Chlorate	per lb.	1/4½	..
a " Crystals	per ton	60/-	..
a Sodium Bichromate, casks	per lb.	8½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	..	..
b " Wire, in ton lots (1 to 14 S.W.G.)	"	..	..
b " Sheet, in ton lots	"	..	..
g Babbitt's metal ingots	"	..	..
c Brass (rolled metal 2" to 12" basis)	per lb.	1/3⅜ to 1/3⅞	..
c " Tubes (solid drawn)	"	1/8½ to 1/4	½d. inc.
c " Wire, basis	"	1/3¼ to 1/8½	½d./⅝d. inc.
c Copper Tubes (solid drawn)	"	1/4½ to 1/5	1d. inc.
g " Bars (best selected)	per ton	£131	£6 inc.
g " Sheet	"	£131	£6 inc.
g " Rod	"	£131	£6 inc.
d " (Electrolytic) Bars	"	£123	£6 inc.
d " " Sheets	"	£141	£6 inc.
d " " Rods	"	£130	£6 inc.
d " " H.C. Wire	per lb.	1/8½	1d. inc.
f Ebonite Rod	"	8/-	..
f " Sheet	"	2/6	..
a German Silver Wire	"	2/2	4d. inc.
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	3/2	4½d. dec.
f Iron Pig (Cleveland warrants)	per ton	85/9	8/9 inc.
f " Wire, galv. No. 8, P.O. qual.	"	£80	..
g Lead, English Pig	"	£32 5	25/- inc.
g Mercury	per bot.	£16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e " " " medium	"	8/6 to 6/-	..
e " " " large	"	7/6 to 14/- & up.	..
o Nickel, sheet, wire, &c.	"	Nom.	..
g Phosphor Bronze, plain castings	"	..	..
g " " rolled bars & rods	"	..	..
g " " rolled strip & sheet	"	..	..
e Platinum	per oz.	..	..
d Silicium Bronze Wire	per lb.	1/6	3d. inc.
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	"	£181 10	£4 10 to £5 10 inc.
n " Wire, Nos. 1 to 16	per lb.	2/9	1d. inc.
g White Anti-friction Metals	per ton	..	..
k Zinc, Sh't (Vieille Montagne bnd.)	"	Nom.	..

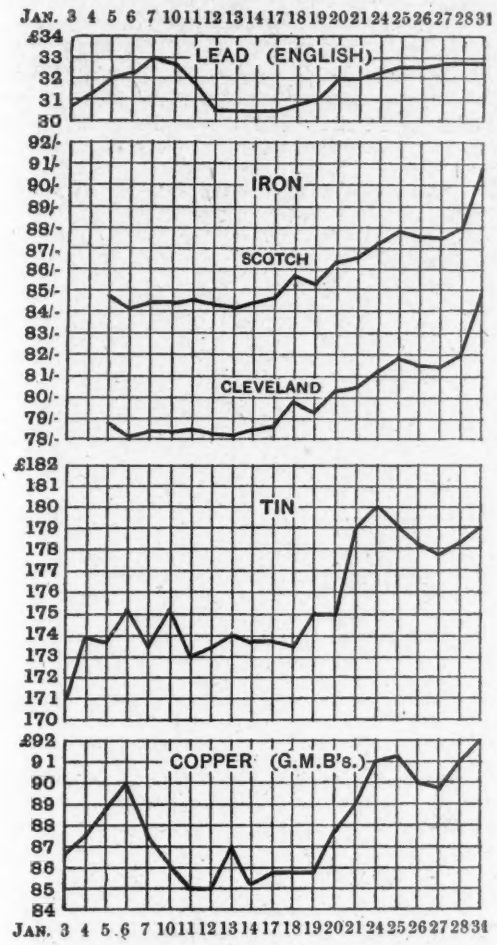
Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
j Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Callender's Hospital Fund.—On Monday last, at the Belvedere Works of Callender's Cable and Construction Co., Ltd., the thirteenth annual report of Callender's Hospital and Distress Fund was unanimously approved. Despite the war and all its disturbing influences the work of the Fund was well sustained during 1915. A large number of members had joined the Colours and naturally subscriptions showed a decrease. The highest sum on record has been, on this occasion, voted to the hospitals. The penny weekly subscriptions amounted to £270 against £281 in the previous year. The Committee resolved not to appeal to the donors this year owing to the war demanding so many calls. The awards to hospitals and other institutions were £285. The report gave particulars of the number of hospital letters issued, and the number of special home-nursing letters granted, and stated that a large number of applicants were supplied with surgical appliances, spectacles, convalescent home letters, and financial assistance.

METAL MARKET.

Fluctuations in January.



Turbine Development in the U.S.—Our contemporary *Power*, in its review of the year, refers to the increasing size of American steam turbine units. Several machines of 30,000 KW. capacity are in service, as is also the 35,000-KW. unit of the Philadelphia Electric Co.; a 40,000 K.V.A. machine has been ordered by the Duquesne Light Co., of Pittsburg; the Detroit Edison Co. is contemplating 45,000 KW. units at a new station to be added to the Delray group; and rumour has it that a 50,000-KW. unit is soon to be built. In connection with large turbine units a two-stage condenser has been proposed, in which part of the steam is to be condensed in the first stage at a vacuum of, say, 29 in., the balance of the steam passing through the final stage of the turbine to the second stage of the condenser under a vacuum of 29½ in. An appreciable gain is expected over the standard condenser, and extremely high vacuums are possible without undue increase in area of the final stages of the turbine.

Australian Patents Board.—The Commonwealth Minister for Public Instruction recently caused the appointment of a Patents Investigation Board, to enable persons who had made inventions likely to be of use to the public, to have the merit of such inventions demonstrated or investigated without cost to themselves. If, after investigation, it is shown that an invention possesses novelty and merit, and is likely to be of assistance to industry, the general Board will consider it, and, if favourable, will recommend the Government to assist the inventor in developing and perfecting it, and experimenting with it.—*Sydney Morning Herald.*

An Inquiry from Lyons.—H.M. Consul at Lyons reports that a dealer in accessories of all kinds for electric lighting, who has considerable orders which cannot be satisfied owing to shortage of local supplies, desires to get into communication with United Kingdom manufacturers of such accessories. (Reference No. 22.) Apply to the Board of Trade Commercial Intelligence Branch, London

MUNICIPAL ELECTRICITY SUPPLY AT JOHANNESBURG.

By R. TURNBULL MAWDESLEY.

(*Continued from page* 101.)

Boiler Plant.—The boiler house, which runs parallel with the engine-room, at present contains 16 boilers in all, 14 being of the standard land type and one of the standard marine type, by Messrs. Babcock and Wilcox, all with integral superheaters; and one "Bettington" atomised-fuel boiler, with superheater and economiser. The steaming capacities of the boilers are approximately as follows:—

3	B. & W. Land type, each of	500 H.P.,	7,000 lb. per hour.
7	" " "	750 H.P.,	11,000 " "
4	" " "	1,000 H.P.,	17,000 " "

The B. & W. marine type boiler has a capacity of 34,000 lb. per hour, and has a stack with the Prat induced-draught system, and an economiser placed above the boiler. All the above boilers have chain grates electrically driven.

The "Bettington" boiler, designed by the late Lieut. Claude Bettington, is not, so far as the writer is aware, very well known in Great Britain, and in view of this a brief description will not be without interest.

This boiler is capable of evaporating 34,000 lb. of water per hour, at 180 lb. pressure, with feed-water at 85° F., and of superheating the steam 150° F.

The broad principle consists in the use of a vertical "gas" (powdered coal) jet inlet, so constructed that an

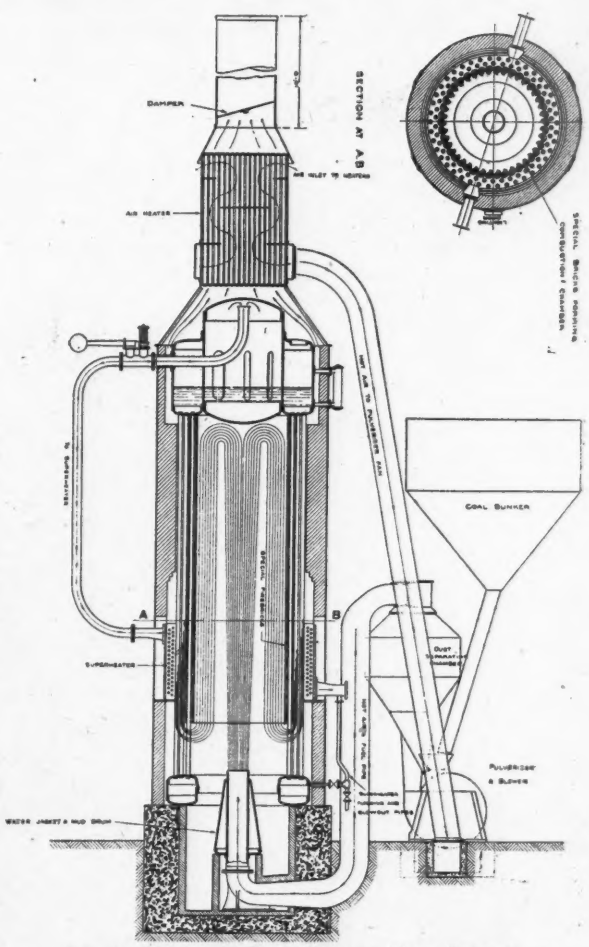


FIG. 8.—SECTIONAL ELEVATION AND CROSS SECTION OF BETTINGTON BOILER, SHOWING PATH OF GASES.

umbrella-shaped flame is produced within a closed ring of vertical water-tubes, which form the main heating surface of the steam-producing plant. Fig. 8 shows a sectional elevation and cross-section of the Bettington boiler.

The coal is powdered by two pulverisers, situated directly in front of the boiler, one being driven by an A.C. motor and the other by a D.C. motor. These pulverisers also act as blowers—and it has been found that one pulveriser is quite sufficient to supply fuel up to the normal output of the boiler. The air supply to the pulveriser is pre-heated by the escaping flue-gases, and by this means

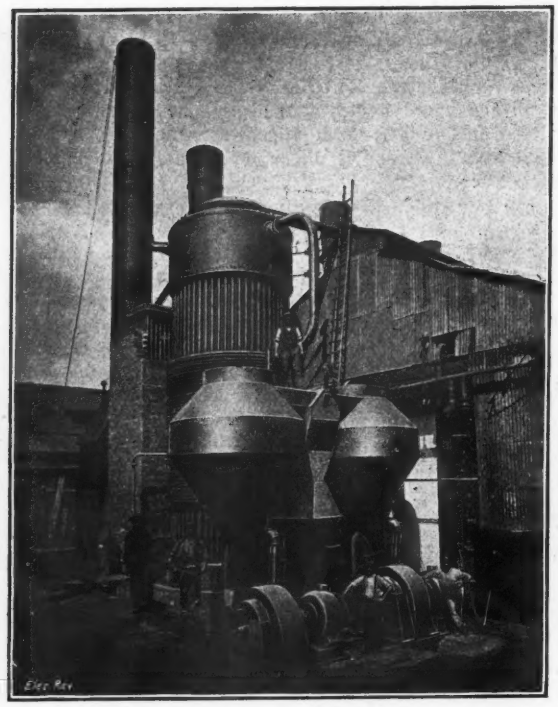


Fig. 9.—Bettington Boiler in Course of Erection.

coal of 15 per cent. moisture is handled satisfactorily. From the pulveriser the coal passes to a separator, the larger and heavier particles returning to the pulveriser and the finer fuel passing direct to the tuyere, which is surrounded by a water jacket, and forms a mud drum.

The tubes surrounding the combustion chamber are lined with refractory material to within a short distance of the bottom header. No fireclay is used in lining this chamber, the fire-bricks being merely stacked in position. The ash of the fuel in its passage through the zone of highest temperature is converted into liquid spray, which quickly fills up the interstices, and the surplus, in time, trickles down to the bottom edge, from which it drips, in small globules, to the ash-pit below. The result is that the furnace keeps itself quite clear of slag at all rates of combustion, and deposits slag in a manageable form—*i.e.*, in globules about $\frac{1}{2}$ in. in diameter, in the ash-pit.

The heating up and continuous ignition of the incoming stream of dust and air, is effected primarily by the enveloping sheath of the products of combustion—a mixture of gases (CO_2, H_2O, and N principally), at a temperature of about 3,000° F.

This "self-igniter" does not change in position more than 10 per cent., no matter how great a velocity is given to the incoming coarse "gas" (coal dust).

Ignition is independent of the incandescent brickwork, which is, in its turn, dependent upon its proximity to the place of combustion for incandescence. The returning gases always ensure incandescent brickwork round the tuyere, and, after a temporary stop, the fire may be re-started by turning on the fuel supply.

The boiler is fired up when cold by means of a Bunsen coal gas jet, which passes through the tuyere. (This gas supply comes from the neighbouring gasworks.) The pulveriser is run with the damper closed until a rich mixing is available, and then the full mixture is turned on. When this coarse "gas" is ignited, the Bunsen flame is turned off, and the fuel and air supply regulated.

It is possible to put this boiler on the range within 25 minutes of lighting up from dead cold—and this is a distinct advantage in a station of low load factor such as Johannesburg. As all the fuel is consumed in suspension, it follows that as soon as the fuel is shut off, the fire is extinguished like a gas jet, and there are practically no stand-by losses.

By means of a CO_2 recorder, or even by observing the colour of the flame, it is possible to regulate the proper supply of air and fuel to obtain absolutely smokeless combustion.

Anthracite coal, of course, is not suitable for burning in this boiler; when pulverised very finely, it burns fairly well, but not so well as coal having a higher percentage of volatile matter.

The boiler is equipped with a superheater, the tubes of which pass round the outside of the lower portion of the water tubes which form the combustion chamber.

The gases pass from the boiler into the feed section (which consists of two steel headers, stayed with expanded steel tubes, together with the necessary feed connections, and brick housing), and from there through the air heater away to the stack.

Fig. 9 shows the Bettington boiler in course of erection, the vertical water tubes and the superheater tubes being visible. The economiser is shown at the rear, and the motor-driven pulverisers and separators in the foreground. (Since the photograph was taken the existing boiler house has been extended to cover in the Bettington boiler.)

Notwithstanding the extra cost of pulverising, &c., it would seem that this boiler is not less efficient than the best known makes of water-tube boiler. It was supplied by Messrs. Fraser & Chalmers, Ltd., to whom the writer's thanks are due for the diagram in fig. 8, and for the figures of the steaming capacity.

Referring again to the Babcock boiler plant, not all

Fig. 10.—Doornfontein Transformer Station.

these boilers are furnished with economisers, only seven economisers in all being installed, apart from the two mentioned. These are of the well-known "Green" make, and each has motor-driven scrapers as usual.

All the make-up water for the boiler feed is derived from the town mains, and is treated by the addition of four gallons of "Noxall" fluid in 24 hours. There is a

small de-oiling tank for electrically treating the condensate before it returns to the feed tanks. The feed pumps are all rotary pumps, partly turbine-driven and partly motor-driven.

An overhead coal bunker extends above the boilers for the whole length of the boiler house, with bucket elevator and conveyor, drawing coal from a sunk hopper, into which the coal is tipped from railway wagons.

An ash tunnel runs underneath the boiler house, along which small skips take the ashes to an end hopper, from which they are elevated to a silo, raised sufficiently above ground to enable carts to draw under. All ashes are removed from the site by the Sanitary Department of the Municipality. The coal and ash-handling plant and the bunkers were installed by Messrs. Reunert & Lenz, Ltd., of Johannesburg.

There are altogether eight stacks, five with the Prat induced-draught system, with two boilers to each stack. The marine type boiler has a stack to itself, as before

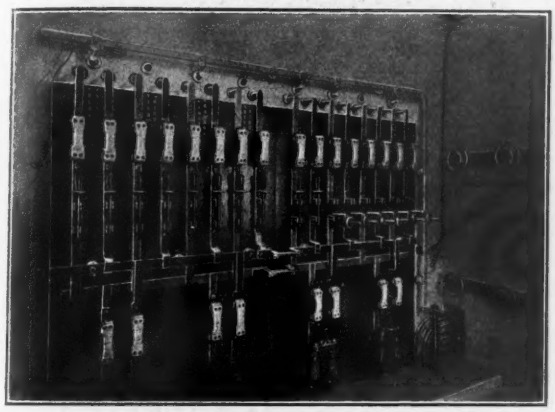


Fig. 11.—Link Chamber, Doornfontein Sub-station.

explained. The Bettington boiler has its own stack with induced draught, and there is a further natural draught stack which accounts for three boilers.

It is, of necessity, a difficult matter to describe a boiler plant, which had originally no design—but which has been added to, from time to time, as the necessity arose. This, as previously pointed out, has been a difficulty with which the Department has had to deal from the beginning—and it is no small achievement to have carried out the work without serious interruption.

With reference to the outer area distribution, fig. 10 shows the subterranean transformer sub-station at Doornfontein. There are actually two chambers here, one containing the transformers and H.T. switchgear (fig. 10), and the other the low-tension distributing board (fig. 11). In fig. 11 the plus and minus signs painted on the bus-bar strips are misleading, the supply being, of course, alternating current, single-phase, at 200 volts.

Similar sub-stations and underground link chambers are in operation at Braamfontein and other important suburban centres, and it may be stated that some 60 townships, apart from the inner area, are at present supplied from the power station. New connections to the mains average about 100 per month.

(*To be continued.*)

Electrically-controlled Change-Speed Gear for Motor Vehicles.—We hear that considerable interest is just now being shown in motor manufacturing circles in a new electrically-controlled system of change speed gear for motor vehicles in which elactro-magnetic clutches play an important part. The arrangement has been submitted to the most exhaustive tests, with the result that one of the largest motor manufacturing concerns in the country is reported to have decided to adopt it on all its new cars when once again it is in a position to revert to the manufacture of cars for the public, the factory being at present entirely engaged on Government work.

CONTROL EQUIPMENTS FOR MACHINE TOOLS.

It has long been recognised by manufacturers and users that to operate a machine tool at its highest efficiency there should be possible a wide variation in speed in each individual tool. When tools are driven from long lines of shafting, this is not economically possible, but when tools are individually driven by electric motors they may be operated at any speeds independent of any other tool in the works.

To obtain the maximum efficiency, therefore, it is not only necessary to adopt individual motor drive for the machine tool, but the control of the driving motor must be simple, free from complication, and enable the operator to obtain the maximum output with the minimum risk.

The motor control should be entirely automatic, requiring no attention from the operator beyond pressing the control button or throwing over the control arm and enabling him to devote his whole attention to the work in hand. The automatic control should ensure that the motor starts, reverses, or stops in the shortest safe time when required, and that it is protected against excessive overloads at all times.

The following control equipments have been developed to meet the above requirements; they are classified under four headings as follows:—

(*a*) Non-reversing control without dynamic braking.
(*b*) Reversing control without dynamic braking.
(*c*) Non-reversing control with dynamic braking.
(*d*) Reversing control with dynamic braking.

The apparatus comprising the complete equipment is determined to an extent by the conditions of service, but all equipments have a common feature in the accelerating unit, which is an automatic device giving full protection to the motor, and ensuring that the machine starts or stops in the shortest safe time.

All these equipments are for constant speed machines, but they can be used for variable speed machines in conjunction with a field rheostat and a relay.

Standard equipments are designed for capacities up to 10 H.P. and for voltages up to 550. Non-reversing control equipments without dynamic braking can also be supplied up to 15 H.P. at 200/250 volts, and up to 25 H.P. at 400/550 volts.

The operation of the equipment is as follows:—When the control switch is closed, current flows through the motor armature, which is then in series with the full starting resistance and the first coil of the series contactor or accelerator, and the motor starts up slowly.

As the speed increases, the current taken from the line decreases, and when it reaches the value for which the

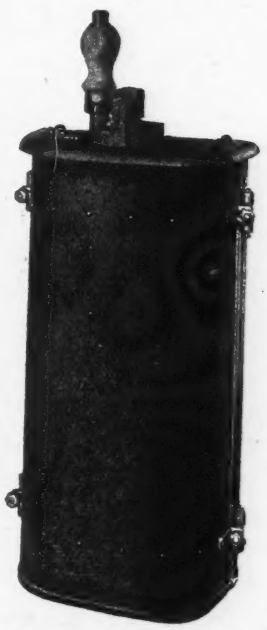


Fig. 1.—Controller for B.T.H. Machine Tool Control.

accelerator is set the first contactor closes and cuts out a section of the starting resistance. This results in a fresh current increment, and the operation is repeated by each contactor until the whole of the starting resistance is cut out and the motor is connected to the line.

The accelerator is designed so that each section of the resistance is cut out in the shortest safe time, while the motor current is kept within safe limits.

Each contactor switch is automatically locked open so long

as the current flowing through its coil exceeds the value for which it is set. The motor is thus protected against excess current at each step of the accelerator.

On moving the control switch to the "off" position, the motor is disconnected from the line, and consequently comes to rest.

Where a quick stop is required, this is accomplished by means of a controller arranged for dynamic braking. When the handle of this controller is moved to the "braking" position the connections are changed, so that all the starting resistance is connected in series with the motor armature. The motor is then quickly brought to rest by dynamic braking, the contactor switches in this case acting as a retarding device and cutting out the resistance step by step as the speed of the motor decreases.

The accelerating unit consists of a number of series contactors, or electrically-operated switches, mounted on a slate

Fig. 2.—Push-button Switch for B.T.H. Machine Tool Control.

base, behind which the starting resistance is mounted, the whole unit being totally enclosed in an iron box suitable for attaching to a wall.

Each contactor when closed short-circuits a section of the starting resistance, so that when all the contactors are closed, the motor is connected direct to the line.

The special feature of these contactors is that they remain open if the current passing through the series-operating coil exceeds a predetermined value, and close immediately the current decreases to that value.

The first contactor coil is connected in series with the starting resistance, so that on closing the control switch the current passes through this contactor coil. As the motor accelerates the current decreases until it reaches the predetermined value at which the contactor is set to operate. The first contactor switch immediately closes and short-circuits the first section of the starting resistance, at the same time completing the circuit through the second contactor coil. This short-circuiting of the starting resistance causes an instantaneous current increase, which locks the second con-

Fig. 3.—Main Switch Fuse for B.T.H. Machine Tool Control.

tactor in the open position until the current again decreases to the predetermined value due to the speeding up of the motor. Each section of the starting resistance is short-circuited in a similar manner.

The whole device is extremely simple, due to the fact that the coil used for closing the contactor is also used to hold it open until the current has decreased to a safe value. The coil, being a series coil, is wound with wire or strip of ample section so that it is not likely to be damaged by the instantaneous current rushes.

The controllers supplied for these equipments are three-way switches built in the form of drum type controllers, and are supplied for reversing or non-reversing.

The controllers supplied for non-reversing control equipments, as well as those for reversing control equipments, are fitted with crank handles which can be moved to any of three stops. In the case of the former for forward running or for braking positions, and in the case of reversing controllers with dynamic braking, these stops correspond to forward running, braking, and reverse running positions. For those without dynamic braking, the stops correspond to forward running, off and reverse running positions.

Controllers are fitted with magnetic blow-out coils, and are suitable for breaking the main current.

The main switch fuse is of the double-pole quick-break type, enclosed in a cast-iron case.

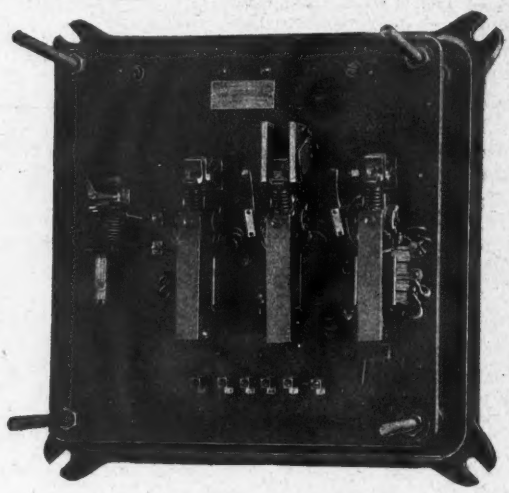


Fig. 4.—Accelerating Unit for B.T.H. Machine Tool Control (cover removed).

Equipments without dynamic braking can be supplied with push-button control, in which case the connections are specially arranged, so that the result obtained on pressing any one button is maintained after releasing the button, and continues until a separate button is pressed.

The construction of this control switch is shown in the illustration. The contacts are mounted on a slate base and enclosed by a metal case, through which the push buttons project.

When variable speed control is required, the foregoing equipments must be supplemented by a hand-operated field rheostat and a field relay to prevent the motor being started with a weak field.

The relay supplied for this extra equipment permits the motor to be stopped and then started again without the risk of starting on a weak field and without the operator having to pay attention to the position of the rheostat handle. Thus, when the field rheostat has been set for a certain cutting speed, the motor will automatically run up to that cutting speed when restarted after a stoppage.

The control equipment described above is supplied by the British Thomson-Houston Co., Ltd., of Rugby, and is giving satisfactory service, not only in their own, but in many other works throughout the world.

THE DESIGN OF HIGH-PRESSURE DISTRIBUTION SYSTEMS.

Mr. J. R. Beard's paper was discussed at a meeting of the Yorkshire Local Section of the Institution of Electrical Engineers, on January 12th, at Leeds.

The Chairman, Mr. H. H. Wright, said that in many Yorkshire industrial districts the demand for power had grown at such a rate during the past few years that the station engineer had found some difficulty in keeping pace with it, the consequence being that many of the feeders were already overloaded; new feeders and transformer stations had had to be put down, and many questions had arisen similar to those dealt with in the paper. He thought the author erred on the side of safety in giving 22½ years as the period of depreciation for underground cables. The committee appointed by the Institution last year to investigate this question had come to the conclusion that a life of 30 years should be allowed for all classes of underground cables if laid with proper regard to the nature of the soil, and suggested 60 years as the life of conduits. In the lay-out of a distribution system it was not the first cost of switchgear that was so important as the fact that by the choice of suitable discriminating gear a saving of many times the cost of the gear might be made in mains, etc. The author made out a very strong case for core balancing and split-conductor systems of protection, but there were many existing systems to which they could not be applied.

Mr. J. E. Storr said he believed that distribution of power to the consumer's terminals for transformation on the site was undoubtedly the method by which they would have to

transmit their larger loads in the future. He thought the general utility of the high-pressure transmission would be enhanced if the gear could be standardised on a pressure of 11,000 volts. The overhead system was undoubtedly the method by which the early development of an undertaking, which had a large area to cover, could be dealt with. He thought that pressures were bound to increase rather than remain stationary, but feared that the splitting-up of a 20,000-volt main to make it economical between sub-stations at such a high voltage would mean more than the number of switches allowed for intermediate sub-stations.

Mr. W. Lang thought that all practice showed that the survey of the route and the estimate of the probable demands that would be made for electrical power on that route were often very far short of what actually took place during a very short period. This had been instanced very especially during the war period; loads had come on to the mains that were never anticipated by the most sanguine of them. The value of the scrap copper of underground cables would, he thought, be more than that of the overhead lines.

Mr. A. R. Chaytor said he thought the best reason for the general neglect of the formula was given by fig. 4, which showed that for quite a considerable portion of the curve the annual cost was practically the same. It was hardly worth while, unless it was a very big undertaking, to work out the formula. He thought the scrap value after 17½ years of overhead lines would be nearer 10 per cent. than 20 per cent. With regard to underground mains and the 22½ years, he would give a 20 per cent. value and think the mains had 20 per cent. of their life left. It was usually forgotten that it was possible to take underground cables across fields for considerable distances; people compared the cost of overhead lines with underground cables to the disadvantage of the latter, from the fact that they were usually laid through the busy portions of towns and had to bear the cost of reinstatement of pavement.

Mr. J. Shepherd said he did not think the author gave full value to the overhead system; in England they did not use that system to anything like the extent that they did in other countries. At Zurich they had actually put up overhead lines for a distance of something like 80 miles. The same system was shortly to be introduced in Berlin. All the inner stations in Berlin were being shut down, and the entire power, which would certainly run to 500,000 kw., would be transmitted by the overhead system a matter of something like 90 or 100 miles. If they could do that abroad he thought the time would come when, in England, they would have to adopt the overhead system for higher voltages. The Treasury usually allowed 25 years for the life of a cable, but he did not see, if cables were laid solid where no surface water came into contact with the lead, why they should not last 100 years. A good deal had been said about the calculation of the economical area, but if the data were incorrect all the calculations would be inaccurate. In getting out this economical area he did not think the author had made any allowance for the capital value of the plant required to compensate for the losses in the cable.

Mr. Wilson Hartnell said that no engineer in his senses would put down an underground wire if he could put the wire above ground. In most of the British Colonies, wherever public opinion was not against it, all the wires were put above ground. The Yorkshire Power Co. was carrying its wires where it could, but what he thought was needed was some very drastic legislation to empower the company to carry the wires over any land, irrespective of what the owners of the property thought of the matter.

Mr. J. H. Shaw said he desired to say a good word for the "change-over tee" system. In the undertaking with which he was connected it had been in operation for 10 years, and he believed they had only had six faults on some 60 miles of extra-high-tension mains. The author discussed the diversity factor as helping the interconnected system; that might be all right for the North-East Coast, but in towns where the trades were similar and started more or less at the same time, and left off at the same time, there was no diversity factor.

The Author, in the course of his reply, said the 22½ years for cables was not intended to be taken as an actual figure; it simply worked out at that owing to his taking 2 per cent. He was very glad that his capital charges had been criticised as being on the high side. He still felt, however, that the figure was somewhere about what it should be, and it did not really conflict with the Local Government Board's revised figures so much as appeared. He agreed that the life of cables was probably very much more than 22½ years, and in the Newcastle district in very few cases had any serious depreciation of cables been found; many of them had been in since 1901, and some which were put in then were as sound to-day as ever. Core balancing was not mentioned in the paper, but his people had used quite a lot of so-called core-balancing protection on single-ended feeders and on rotary-converter transformers, where it was very useful in giving an instantaneous trip on faults. He rather doubted whether one could usefully standardise voltages at present; what should be standardised was the frequency. His firm were putting up large mileages of overhead lines at present; there was no doubt, however, that in the North-East Coast district, if one talked to the operation people they would ask for cables every time. There were many ways in which overhead lines could be damaged, quite apart from questions of design; for example, they could not do away with hay blowing off a hayrick. The overhead lines were found to be useful in the early stages of development. Recently his firm had connected up a very big amount of munition load, and, in all cases, it had been so easy to do it that the supply had been available months before the firms had been ready to take it, although, in many cases, they were seven or eight miles from the company's power stations. The split-conductor for use on existing cables by running them in duplicate had been developed, and was now in quite successful operation. He believed his firm found that 2½ switches per sub-station was quite a reasonable figure. In the majority of sub-stations they only required two. He could not agree that the old rule-of-thumb was all right, but it was rather a surprise to him, in going through these calculations, to find that the densities came down to about the old figure of 1,000 amps. per sq. in. They had taken underground cables in many instances across fields, and, as a rule, it was more difficult to arrange for overhead lines. In open agricultural country the cables would have to be laid deeper than they had to be in the roads. He believed in Berlin they were experimenting with something like 60,000-volt underground cables. When he said that there were twice as many faults in overhead lines as in cables, they must not conclude that there was a great number of faults on the former. It simply meant that there were very few faults in the cables, and the number of faults they got on the overhead lines was quite sufficient to annoy consumers and, hence, generally forbade their use. Inductance in feeders had the disadvantage of tending to limit the area of distribution, and it should be avoided. The Americans, who strongly recommended inductance in feeders, were the people who had done nothing to develop switch design for about ten years. They brought out, ten years ago, a switchgear which was better than they had in England, but he did not think that that position of affairs obtained now. Rotary condensers had been used in two cases in Durham, with very satisfactory results. He quite agreed that one could do too much calculation in designing actual extensions. He had allowed for the capital value of the plant to supply the losses. In America water-power transmission had forced them into the use of very high voltages, and his eyes had been very much opened by some figures he had seen in an American paper with regard to the number of breakdowns on overhead lines on a large system. The figures were half-a-dozen times as great as one would expect on an English system. One thing which explained the use of overload lines in America was that there they did no mind a temporary interruption so much as did English people. Electrical people in America had got a free field, and if consumers did not want their supply they need not have it. In England, however, circumstances were entirely opposite. Here electricity competed all the time against other forms of power and lighting. On the North-East Coast it was almost invariably possible to couple up consumers on the interconnected system without any consideration whatever for the effect it would have on the protective arrangements of the rest of the system. On the North-East Coast they had very varied industries, and the industries themselves had very variable loads, and it was not a question of starting up a big block of machinery at a certain time and shutting it down at another time. The cost of the protective devices, he thought, could be readily explained by the fact that they had, up to the present, been used on very large systems, and the corresponding switchgear had been developed to suit these systems, and that was very expensive. If there was a demand for, say, the split-conductor system on lighter forms of gear, it should be readily designed to suit requirements.

ELECTRICAL ENGINEERS AND THE MOTOR CAR TRADE.

A question of some importance to electrical engineers was discussed at the meeting of the Agents' Section, Ltd., and the Motor Trade Association, which has just been held at Leeds. It may be mentioned that the first-named body is the Agents' Branch of the Society of Motor Manufacturers and Traders, while the M.T.A., as it is usually known, is an association of motor traders whose object is that of preventing, as far as possible, other than recognised and legitimate motor traders from securing trade terms, and of preventing price-cutting in manufacturers' standard productions. The main point under discussion was whether electrical engineers were entitled to trade terms on motor goods.

The opening speaker was Mr. G. Hubert Woods, of the British Westinghouse Co., Ltd., who stated that, as regards his company, the matter of electricians was a difficult one. The difficulty arose from the fact that they had a large number of electrical customers all over the country who were entitled to trade terms on electrical parts. Therefore, if trade terms were given to a firm on a dynamo which was going to be put on the floor, the question was naturally asked why trade terms should not also be given on a dynamo which was going to be put on a motor car. It was difficult for a manufacturing company to say, "unless you are *selling* motor cars, we cannot give you trade terms." He thought electrical motors would be very prevalent in the future, and he considered the right thing for both bodies was to legislate

for a condition of things which could be seen coming, before it came. It would not necessarily be assumed that because electrical firms were admitted to membership of the Motor Trade Association, they were entitled to the same terms as motor agents. Manufacturers could give them a discount of some sort or other, but continue to give to the members of the motor trade the same discount as at present. Mr. Woods concluded by stating that if it would help matters along, he would propose that a class for electrical engineers be formed by the Motor Trade Association, and that they be admitted under that category provided their applications were proposed by the local division of the Association.

Mr. A. Goodwin, of Messrs. C. A. Vandervell & Co., Ltd., said that he did not agree with Mr. Woods' remarks as to it being difficult to define the difference between trade in a dynamo that was to be fixed on a floor and one that was to be affixed to a car. In his opinion, the line of demarcation was one of definite character. When a firm received an application for trade terms from electrical people, there was generally something which cropped up in the correspondence, or on the notepaper of the firm applying for trade terms that would give some clue as to the class of business the firm in question were doing. As regards his company, if the notepaper did not give any indication, their travellers on the spot made certain inquiries. In the case of lamp bulbs, however, it was impossible to refuse to supply them at full trade terms to any electrical firm in the trade, and, therefore, in his opinion, Mr. Woods' suggestion that the manufacturers should give electrical firms one class of terms and the legitimate motor trader another was one that could scarcely be followed in practice, although very nice in theory. The point was to give the manufacturer some basis to work upon, but he did not think the organisation could move in the matter as to where the line of demarcation should be drawn.

Mr. A. Noel Mobbs, of the Pytchley Autocar Co., Ltd., of Northampton, expressed the opinion that electrical firms should not be included in the M.T.A. It was, however, going too far to say that nobody but motor firms legitimately in the motor trade should be supplied with accessories in the electrical line which were fixed on motor cars at any discount whatever. If a few lamp bulbs were sold by electrical firms and used on motor cars, surely they could stand that. He thought the Association should go for simplicity, and that it would be sufficient to say that electrical firms should have trade terms on proper electrical goods without bringing them into the Association. He would propose a resolution to that effect.

In closing the discussion, the Chairman, Mr. A. R. Atkey, of Nottingham, said that it was no use trying to close one's eyes to the fact that the *bona-fide* electrical engineer was not only entitled to trade terms on electrical goods, but was looming on the horizon as one of the most important factors in connection with the motor industry, and if a deaf ear were turned to their application to join the Association, the time might come when the Association might feel sorry, and electrical firms might decline to carry out the interests of the trade. The ideal of the Association was not to prevent anybody earning a legitimate livelihood, but to embrace in the ranks and cover by its influence all those who could help in the general advance of the movement. The question the meeting had to decide was as to whether they would admit electrical engineering firms to a section, or whether they would close the Association against them and leave them outside and uncontrolled.

Eventually the following resolution was adopted:—"That in the opinion of this meeting electrical engineers shall be entitled to trade terms on electrical goods, but shall not be entitled to membership of the Agents' Section, Ltd., or the Motor Trade Association, or to trade terms on motor cars or accessories other than electrical, and that price maintenance agreements must be obtained from them."

Commenting on the meeting, the *Motor Trader*, to whom we are indebted for our summary of the proceedings, concludes:—"On the whole, the resolution, though in the nature of a *via media*, provides an acceptable solution of the problem. Electrical engineers may have no more than an academical interest in the motor trade, but to suggest that the manufacturers of electrical goods should recognise the distinction between motor and non-motor goods in supplying them would be imposing an almost impossible obligation. It is desirable, however, that eligibility for trade terms on one class of motor goods should not carry with it a similar privilege in regard to all motor goods."

ELECTRIC GENERATING STATIONS IN CHINA.

By Prof. C. A. MIDDLETON SMITH, M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* Hong-Kong Local Centre of the Institution of Electrical Engineers.)

China is a country which, for practical purposes, is entirely devoid of roads. It is quite probable that 90 per cent. of the inhabitants of China have never heard of a steam engine, or of a heat engine of any description. The number of Chinese who have any idea of what is meant by the words "electrical power station" cannot be one-tenth of one per cent. of the population. Possibly about 10 per cent. of the people have seen the ordinary electric lamp, and about one-tenth of that number have seen a gas lamp.

In the whole of China there are only three places in which modern industrialism is even attempted on any scale such as is common in towns of, say, 50,000 inhabitants in England. These places are Hong-Kong (a British colony), Shanghai (a foreign settlement), and Hankow. In these places the work of the electrical engineer is very much in evidence.

The Hong-Kong dockyards probably employ about 600 Europeans and about 7,000 Chinese workmen.

The three dockyards are well equipped with all modern machine tools, many of which are motor-driven. In the Taikoo Dockyard there is a large central power station containing 1,000-B.H.P. gas engines and continuous-current generators with a total capacity of 2,250 KW. Mond gas producers supply the fuel for the engines. In the Naval Dockyard there is a central station with steam and Diesel engines.

In the colony of Hong-Kong there are two public electricity supply companies. That which is on the island and supplies the city of Victoria has a station containing 2,000 KW. of Diesel engines and 600 KW. of steam engines, and a new steam turbine-driven station is being planned. The present price of electrical energy as supplied by this company is 6d. per unit for lighting and 1½d. and 1¼d. for power. There is also a separate generating station for supplying power to the tramways. This is steam-driven, and probably will disappear in time. The Hong-Kong University has its own central station, installed largely for educational work, with a total capacity of rather over 100 H.P. of gas, oil, and steam engines, a steam turbine, and a Pelton wheel.

In Kowloon, on the mainland portion of the colony of Hong-Kong, the China Light & Power Co. supply light and power. Their plant is rated at 516 KW., but 1,500 KW. is to be installed this year.

Near Hong-Kong there is the Canton Electric Supply Co. Canton is the most populous and progressive city in China. There are well over a million inhabitants. The Canton Supply Co. uses steam and Diesel engines—it was originally a steam-engine station—and its total capacity is 1,540 KW. The Chinese shopkeeper is willing to pay high prices for electric light, and uses it in a most lavish fashion.

The great centre of electrical development in China is Shanghai. The conditions are more favourable in Shanghai than in any other place in the Far East for such enterprise, but at the same time many opportunities have been seized there which might easily have been lost.

The Shanghai generating station compares most favourably with anything of its kind in Europe or America. It is, indeed, a model for the Far East, and British engineers should be very proud of the fact that it has been built up under the direct personal supervision of a Britisher.*

The station is steam-driven with two 5,000-KW. and two 2,000-KW. turbines. Quite recently the chief engineer has suggested extensions which amount to 20,000 KW. It is almost certain that this region will be the first part of China to develop works and factories on a large scale.

An English firm have installed 102 steam engines in China, with a total rating of 28,960 B.H.P. Most of these are used for electricity supply.

Another British firm have installed in North China at Soochow a 375-KW. 3-phase alternator, direct-coupled to a high-speed steam engine, complete with high-tension switchboard, etc. In Chang Chow there is a 150-KW. 3-phase alternator direct-coupled to a high-speed steam engine complete with water-tube boilers, high-tension switchboard, transformers, etc. In Tientsin there are two 75-KW. continuous-current generators coupled to high-speed steam engines, supplied for extension lighting of the Japanese settlement. Further contracts recently secured are for the lighting of two other large Chinese cities; the electrical plant consists of one 200-KW. and one 150-KW. 3-phase alternator. A large number of single-phase and 3-phase motors from 5 up to 100 H.P. have also been supplied for use in cotton mills and other factories. An outlet for electrical plant is found in up-country hospitals, missions, and private Chinese residences where small dynamos driven by oil engines are very much in favour. Many small steam engines and dynamos for lighting river steamers have been sent to South China, as well as small oil-driven sets for hotels and private houses.

A merchant firm state that they have supplied various electric lighting installations in South China, including a large number of small private plants from 1 KW. to 10 KW.; also one 12-KW. 100-volt continuous-current set direct-coupled to a vertical semi-Diesel engine at Tung Shan, Canton. A large European firm have supplied important plants in the South.

In the case of the new installations the general practice at present seems to show that the Chinese commence on a scale of rather under 100 KW. Take a small oil-engine installation of 50 KW. The capital cost of the engines, foundations, dynamos, and switchboard would be (roughly) $13,000 (£1,300). A rough building and land would probably bring it up to $15,000 (£1,500).

We find at the University that crude oil can be used as fuel to cost less than 2¼ cents (¼d.) per unit; lubricating oil, and

*A full description of this station appeared in the Elec. Rev. of November 5th, 12th and 19th, 1915.

waste, etc., say ¼ cent (½d.) per unit. Wages for supervision, drivers, etc., $200 (£20) a month, say $2,400 (£240) per annum. The output of the station is reckoned at 50,000 units per annum. The total generating costs are about 11 cents. (2¾d.) per unit. As overhead mains may be used, the distribution costs are low. Experience has shown that the Chinese will pay 25 cents (6¼d.) a unit, and there is clearly a very good margin of profit.

There is practically no legislation in China concerning electric supply, and if progress continues as at present, there will be endless annoyance and confusion for engineers and customers in a few years.

After two years of study of the subject, the author has the impression that at present the demand for electrical apparatus in China is on a comparatively small scale. Shanghai is the one great exception.

There is a great desire among all classes of the Chinese to have electric light, and experience in and around Hong-Kong seems to prove that they are quite willing to pay for it at even extravagant prices.

The plants already installed are having an educational effect. In nearly all cases extensions are contemplated.

The Chinese are particularly anxious to make use of applied science. The simple statement that, of the 167 students in the Hong-Kong University, 92 have selected engineering as a profession, shows quite clearly the direction of the thoughts of the more progressive parents.

Up till the present there has been practically nothing in the nature of an educative campaign on behalf of electrical machinery in China. There are difficulties, financial and administrative, to be overcome before this market is greatly increased, but the greatest difficulty of all is to provide object lessons to the Chinese, and to supply information and unbiased advice. In the furtherance of that work the Engineering Department of the Hong-Kong University will be happy to do its utmost.

The large oil companies are busily extending their market all over China. Possibly the immediate developments inland will be brought about by the use of oil engines or water turbines. The use of coal inland is not probable in the immediate future. Even in South China it is necessary to use Japanese coal, and the price seems to be about $10 (£1) per ton. The fuel problem is one that will be solved easily, when the Chinese begin properly to develop their own natural resources. The electrical engineer has to compete only with such crude illuminants as the candle and oil lamp.

In the discussion that followed, Mr. E. T. Williams said that without co-operation Great Britain could not hope to reap the possibilities of electrical work in a vast country like China. If this prospective market was to be really exploited, what was wanted was co-operation embracing the selling of machinery, the undertaking of contracts, and the devising and financing of electrical schemes; in other words, they must employ in China methods adapted to the circumstances of the country. The electrical and engineering firms of Great Britain should combine their resources for China, and then, having studied the possibilities, should distribute throughout the country a properly organised business network, largely composed of educated Chinese engineers under European control. This organisation should conduct in China the business of the united British interests. In time it would become a self-supporting organisation, and would create a great demand for the electrical manufactures of Great Britain.

Mr. D. W. Munton said that, assuming that a Chinese came down from the interior to purchase machinery, he was generally discovered by the various compradores, into whose clutches he fell; not one, but several estimates were submitted, and disastrous competition followed, the result of which was that, in order to be in the running, the very minimum of machinery was offered, together with a vaguely worded tender. When the contract was finally awarded, the firm in question generally began to consider what items not absolutely indispensable could be cut out. Unfortunately, contractors of repute there had to compete with firms who sold anything from tintacks to aeroplanes; and some of these firms, having very little in the way of reputation to live up to, promised anything, and seldom fulfilled their promises.

Mr. W. L. Carter said that it was not true that industrially the country was unorganised. China was the cradle of trade unionism, and the guilds had held complete control for many centuries. It was due to the great efficiency of these guilds that this people had resisted the introduction of modern methods into their ancient industries. Before any large schemes could come to fruition the whole question of security for both foreign and native capital would have to be satisfactorily settled.

Prof. T. H. Matthewman held that if electricity was to appeal to the majority of China's millions, it would be from the standpoint of its economy as compared with existing illuminants. This was the vital point in a country such as China, where the scale of living was so low. He bore out what the author said about the importance of the engineering graduate as a factor in the development of the electrical industry in China. The American manufacturer had realised the importance of training such graduates, who came back to China to represent these firms and push American goods. If British manufacturers would offer similar conditions, it would be greatly to their advantage in the future.

Mr. G. E. Marley emphasised the great need in Hong-Kong and China generally for the unbiased consulting engineer.

Prof. Smith, in reply, agreed with Mr. Williams concerning co-operation, and mentioned that the British Electrical and Allied Manufacturers' Association had guaranteed the electrical equipment for the Hong-Kong University—a most excellent example of co-operation.

TRADE STATISTICS OF SPAIN.

The figures given below show the imports of electrical and similar goods into Spain during the year 1914, according to the official statistics recently issued. It will be observed that in both years German trade predominated in practically every branch. The growing share of the United States is also noteworthy. The figures for 1913 are given for purposes of comparison, and notes of increases and decreases (which are very considerable) have been added:—

	1913. Pesetas.	1914. Pesetas.	Inc. or dec. Pesetas.
Arc lamps.—			
From Germany	90,000	66,000	– 24,000
,, France	18,000	10,000	– 8,000
,, Great Britain ...	83,000	29,000	– 54,000
,, Other countries ...	11,000	10,000	– 1,000
Total	202,000	115,000	– 87,000
Dynamos, electric motors, induction coils, resistances, transformers, etc., up to 400 kg. weight.—			
From Germany	5,269,000	2,806,000	– 2,463,000
,, France	1,270,000	575,000	– 695,000
,, Great Britain ...	967,000	551,000	– 416,000
,, Switzerland	236,000	132,000	– 104,000
,, United States ...	736,000	666,000	– 70,000
,, Other countries ...	498,000	650,000	+ 152,000
Total	8,976,000	5,380,000	– 3,596,000
Ditto, weighing from 401 to 2,500 kg.—			
From Germany	3,395,000	1,597,000	– 1,798,000
,, France	786,000	333,000	– 453,000
,, Great Britain ...	866,000	399,000	– 467,000
,, Switzerland	463,000	82,000	– 381,000
,, United States ...	890,000	532,000	– 358,000
,, Other countries ...	508,000	412,000	– 96,000
Total	6,908,000	3,355,000	– 3,553,000
Ditto, weighing from 2,501 to 5,000 kg.—			
From Germany	749,000	387,000	– 362,000
,, Switzerland	217,000	89,000	– 128,000
,, Great Britain ...	215,000	63,000	– 152,000
,, United States ...	743,000	694,000	– 49,000
,, Other countries ...	327,000	336,000	+ 9,000
Total	2,251,000	1,569,000	– 682,000
Ditto, weighing more than 5,000 kg.—			
From Germany	5,634,000	2,564,000	– 3,070,000
,, France	713,000	489,000	– 224,000
,, Great Britain ...	266,000	571,000	+ 305,000
,, Switzerland	377,000	189,000	– 188,000
,, United States ...	3,045,000	2,025,000	– 1,020,000
,, Other countries ...	14,000	66,000	+ 52,000
Total	10,049,000	5,904,000	– 4,145,000
Accumulators and electric batteries.—			
From Germany	60,000	47,000	– 13,000
,, France	66,000	68,000	+ 2,000
,, Great Britain ...	104,000	17,000	– 87,000
,, United States ...	16,000	23,000	+ 7,000
,, Other countries ...	27,000	37,000	+ 10,000
Total	273,000	192,000	– 81,000
Cables and wires for electricity, with or without insulating material, of 1 cm. dia. or more.—			
From Germany	2,279,000	895,000	– 1,384,000
,, Great Britain ...	1,096,000	149,000	– 947,000
,, United States ...	51,000	137,000	+ 86,000
,, Other countries ...	311,000	532,000	+ 221,000
Total	3,737,000	1,713,000	– 2,024,000
Ditto, less than 1 cm. in dia.—			
From Germany	296,000	207,000	– 89,000
,, France	45,000	33,000	– 12,000
,, Great Britain ...	105,000	22,000	– 83,000
,, United States ...	9,000	23,000	+ 14,000
,, Other countries ...	30,000*	8,000	– 22,000
Total	485,000	293,000	– 192,000

* Switzerland 2,400.

	1913. Pesetas.	1914. Pesetas.	Inc. or dec. Pesetas.
Carbons for arc lamps.—			
From Germany	102,000	63,000	– 39,000
,, France	11,000	13,000	+ 2,000
,, Great Britain ...	9,000	15,000	+ 6,000
,, Other countries ...	3,000	2,000	– 1,000
Total	125,000	93,000	– 32,000
Telegraph and telephone apparatus, electric meters and parts.—			
From Germany	2,390,000	1,641,000	– 749,000
,, Belgium	55,000	45,000	– 10,000
,, France	344,000	174,000	– 170,000
,, Great Britain ...	677,000	448,000	– 229,000
,, Sweden	90,000	261,000	+ 171,000
,, United States ...	26,000	11,000	– 15,000
,, Italy	83,000	3,000	– 80,000
,, Other countries ...	41,000	34,000	– 7,000
Total	3,706,000	2,617,000	– 1,089,000
Electrodes.—			
From Germany	14,000	15,000	+ 1,000
,, Italy	—	13,000	+ 13,000
,, Other countries ...	15,000	6,000	– 9,000
Total	29,000	34,000	+ 5,000
Incandescent electric lamps, mounted.—			
From Germany	4,667,000	2,105,000	– 2,562,000
,, France	347,000	48,000	– 299,000
,, Great Britain ...	63,000	47,000	– 16,000
,, Austria	158,000	215,000	+ 57,000
,, Other countries ...	85,000	742,000	+ 657,000
Total	5,320,000	3,157,000	– 2,163,000
Hydraulic motors.—			
From Germany	1,187,000	611,000	– 576,000
,, France	244,000	193,000	– 51,000
,, Great Britain ...	47,000	29,000	– 18,000
,, Switzerland	829,000	387,000	– 442,000
,, Other countries ...	5,000	50,000	+ 45,000
Total	2,312,000	1,270,000	– 1,042,000
Steam and gas engines (stationary) up to 10,000 kg. weight.—			
From Germany	555,000	298,000	– 257,000
,, Great Britain ...	784,000	490,000	+ 294,000
,, France	59,000	88,000	+ 29,000
,, Belgium	62,000	247,000	+ 185,000
,, Other countries ...	92,000	60,000*	– 32,000
Total	1,552,000	1,183,000	– 369,000
* Italy 39,000.			
Ditto, from 10,000 to 25,000 kg. weight.—			
From Germany	191,000	39,000	– 152,000
,, Great Britain ...	153,000	112,000	– 41,000
,, Belgium	71,000	59,000	– 12,000
,, Other countries ...	40,000	35,000	– 5,000
Total	455,000	245,000	– 210,000
Ditto, over 25,000 kg. weight.—			
From Germany	3,069,000	579,000	– 2,490,000
,, Belgium	140,000	88,000	– 52,000
,, Great Britain ...	123,000	404,000	+ 281,000
,, Other countries ...	43,000	163,000*	+ 120,000
Total	3,375,000	1,234,000	– 2,141,000
* France 163,000.			
Cylindrical steam boilers.—			
From Germany	119,000	55,000	– 64,000
,, Great Britain ...	356,000	151,000	– 205,000
,, France	111,000	37,000	– 74,000
,, Belgium	71,000	92,000	+ 21,000
,, Other countries ...	1,000	—	– 1,000
Total	658,000	335,000	– 323,000
Multitubular boilers.—			
From Great Britain ...	2,835,000	1,540,000	– 1,295,000
,, Germany	733,000	476,000	– 257,000
,, Belgium	328,000	196,000	– 132,000
,, France	621,000	346,000	– 275,000
,, Other countries ...	64,000	24,000	– 40,000
Total	4,581,000	2,582,000	– 1,999,000

Note.—25 Pesetas = £1.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

695. "Trolley system electric tramways." A. Cameron. January 17th.

710. "Air inlet attachment for sparking plugs of internal combustion engines." J. Knight. January 17th.

731. "Electro-magnetic shuttle throwing gear for weaving looms." Bachelet Shuttle & Loom Co., and W. Routledge. January 17th.

723. "Electrically-operated portable vacuum cleaners." H. Scholey. January 17th.

731. "Wireless telegraph transmitters." C. S. Franklin & G. Marconi. January 17th.

732. "Wireless telegraph transmitter." W. S. Entwistle & G. Marconi. January 17th.

775. "Electric resistances." W. F. Jones. January 18th.

801. "Shade-holders for gas or electric light fittings." R. W. McLachlan. January 18th.

802. "Electric switches." British Thomson-Houston Co. (General Electric Co., U.S.A.). January 18th.

812. "Combined trench signalling electric lamp and message block." J. W. Mander. January 18th.

820. "Telegraphic transmission of pictures." T. T. Baker & G. E. Heyl. January 18th.

821. "Dynamo-electric machines for the lighting and ignition of internal-combustion engines." G. H. Woods. January 18th.

850. "Method of control by electro-pneumatic device for playing piano, etc., from the keyboard of a concertina." N. W. M. Holt. January 19th.

869. "Electrical relay systems." Siemens & Halske, Akt. Ges. January 19th.

876. "Telephone systems." L. C. Bygrave & Relay Automatic Telephone Co. January 19th.

894. "Current limiters or mercury meters." K. Pettersen. January 19th.

904. "Mica cutting machines in connection with direct-current generators." J. H. Berry & D. A. Turner. January 20th.

930. "Electric lamps." P. E. Weston. January 20th.

948. "Electric switches." Testors Fabriks-Aktiebolag & J. F. Testor. January 20th.

951. "Electric indicators." P. M. Lincoln. January 20th.

955. "Electrical condensers." H. R. van Deventer. January 20th.

967. "Electric lighting device." G. Weissmann. January 20th.

972. "Coin freed telephonic apparatus." F. M. Balding, G. S. P. Scantlebury, & J. E. Scantlebury. January 20th.

999. "Sparking plugs and manufacture of same." T. Crosbee & Sons and W. J. Spicer. January 21st.

1,035. "Whistle and electric torch combined." P. B. Roth. January 22nd.

1,037. "Mouthpiece for telephone instruments." J. Knight. January 22nd.

1,038. "Electric lampholders, adaptors, etc." J. C. White. January 22nd.

1,040. "Electrical machines for use alternatively as motors for starting engines and as generators driven by the engines." C. H. Stevenson. January 22nd.

1,053. "Couplings for armoured cables and electric conductors for use under water." G. Fiorentino & V. C. H. Gibson. January 22nd.

1,063. "Electrolytic extraction of zinc." Metals Extraction Corporation, H. F. K. Picard & H. L. Sulman. January 22nd.

PUBLISHED SPECIFICATIONS.

1914.

24,335. Electric Arc Lamps. G. A. Hughes (trading as London Electric Firm). December 19th.

24,701. Automatic Phonographic Responding and Receiving Devices for use with Telephones. F. Seelau & A. M. Newman. December 28th. (December 30th, 1913.)

1915.

82. Electric Current Modulators, more particularly for Microphones, Electric Vibrators, and the like. F. Morano. January 2nd.

188. Cord Gripping means suitable for Incandescent Electric Lamp-holders. C. Pressland. (Cognate application No. 562/15.) January 5th.

190. Electrical Combined Lighting and Starting Systems for Motor Vehicles and other purposes. M. Wuillot. January 5th. (January 24th, 1914.)

398. Wireless Telegraphy. Signal G.m.b.H. January 9th.

484. Electric Transformer and Circuit Arrangements therefor. G. J. Van Swaay & H. I. Keus. January 12th. (January 27th, 1914.)

580. Manual and Semi-automatic Telephone Systems. Relay Automatic Telephone Co. & W. Aitken. January 14th. (Cognate application, 869/15.)

1,802. Phase Advancers for Dynamo-electric Machines. G. Kapp. February 4th. (Cognate application No. 4,795/15.)

3,710. Frames or Racks for use in Charging Secondary Electric Batteries. J. G. Patterson. March 8th.

3,774. Electric Signalling Apparatus. E. Walker. March 9th.

4,564. Electric Motors. F. Hornby. March 24th.

5,594. Field, Telephone, or Telegraph Wire Reel. G. Dod. April 14th.

5,909. Telephone Call Recorder. F. P. Reid. April 20th.

6,244. Telephone Transmitters. M. S. Conner & A. R. Kahl. April 27th.

15,081. Joint for Electric Light Fittings, particularly applicable to Portable Electric Lamps. H. J. C. Forrester (J. W. Dunham, U.S.A.). October 25th.

Manchuria.—According to *Eastern Engineering*, a company of Chinese and Russian capitalists has been organised under the name of "Energia" to undertake the construction of an electric street railway and power plant at Harbin. A joint stock company is proposed in which the municipality will take an interest if a proper franchise is granted.